The Dock and Harbour Authority

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Editorial Comments

Aftermath of Victory.

In days of remote antiquity, as related in classical history, a deity named Janus (from whose name, by the way, is derived that of the month of January) was worshipped in a temple at Rome, the gates of which remained open for prayer and sacrifice during time of war and were closed during peace. During the past month, metaphorically speaking, the gates have again been closed, and the civilised world once more is breathing freely after the tense experience of six long wearisome years, in which warfare has been waged in many countries and in varied climes, in its most acute and devilish form; it now looks forward to the enjoyment of the blessings of peace. For this relief the entire nation, with its allies and friends, is devoutly thankful and has publicly expressed its gratitude to Almighty God.

History tells us that during the Roman Era of conquest and aggrandisement, for a period of some 700 years, the gates of the temple of Janus were only closed thrice. It cannot be claimed, however, that modern civilisation has shown any improvement on this bellicose record, for if the peaceful intervals have perhaps grown longer, there is much greater intensity of destruction whenever war breaks out, and now that the "atomic bomb" has made its appearance, there will be universal apprehension lest its devastating properties should result in a world-wide cataclysm. Everywhere will arise a fervent prayer that the warning which it has conveyed may be effective in restraining ambitious nations and individuals from embarking on aggressive military policies.

Henceforward, it is the imperative duty of the nations to concentrate their efforts on an endeavour to exploit the newly-won peace to the fullest possible extent, and, for the sake of mankind generally, to restore the atrophied activities of commerce. This will be no easy task. If "Peace hath its Victories no less renowned than War," it also has problems of great magnitude, which will demand the exercise of high statesmanship to solve and vigorous determination to carry out their solutions.

In particular in this country port affairs will call for careful handling in order to revive former interests and renew commercial connections which have been broken or suspended. Apart therefrom, there are fresh associations to be cultivated and new enterprises to be undertaken under new conditions. The advent of the aeroplane and the flying boat introduces a new factor into port operation. Its effect on shipping and sea surface craft remains to be seen, but already there are abundant indications that aerial transport will claim an important share in harbour accommodation.

Not that shipowners view the situation with undue concern. The Cunard-White Star Line have shown their confidence by ordering new vessels of large size, including one of the calibre of the *Mauretania*. Port authorities will, therefore, have to keep a watchful look-out on impending developments in order that their quayside and dock accommodation may be equal to new demands.

Ardrossan Harbour.

The Scottish county of Ayrshire possesses quite a number of busy ports and harbours along its coastline, and, not least in importance is Ardrossan, which lies in the northern part of the county at the entrance to the Firth of Clyde. Originally a fishing village, it has in modern times extended its sea-borne trade to include substantial exports of coal and iron from the neighbouring collieries and ironworks, and imports of timber, ores and general goods. Moreover, it has a flourishing passenger traffic with lines of steamers plying before the war to Glasgow, Arran, Belfast and Newry and even so far afield as ports in Spain.

The account in this issue of the activities of the Ardrossan Harbour Company from the pen of Mr. Harry Hopperton, the energetic director in charge, will therefore be read with interest. The Harbour is one of the small number of British harbours controlled by a private company and worked for profit, affording an illuminating example of what can be done by private enterprise in port management.

The association of Ardrossan with the family of Eglinton and Winton is clearly indicated by the name of one of the docks; indeed, it is largely due to the public spirit of the 12th Earl of that name at the beginning of the 19th century that the port has risen to commercial significance. The harbour, the work on which was commenced in 1806, was intended to be a terminus for a canal from Glasgow, designated "the Glasgow, Paisley and Ardrossan Canal." Although the Canal was commenced and actually constructed for a length of ten miles from Glasgow, the undertaking was never completed and after various vicissitudes, it was eventually abandoned and the site passed into the hands of the Glasgow and South Western Railway to be utilised for the construction of a line called the "Paisley Canal Line." The canal, therefore, is now nothing but the name of a by-gone enterprise. The port, dissociated from the canal, has achieved its

Editorial Comments—continued

prominence independently of its former adjunct and stands on its own merits as a vigorous Scottish seaport.

Wreck Removal at British Harbour Entrances.

In commenting last month on the subject of the rehabilitation of war damaged ports we alluded to the difficulties caused by submerged obstacles, principally craft which had been deliberately scuttled by the enemy with the object of blocking port entrances and so preventing their use for military and commercial purposes. In addition to vessels which were intentionally sunk, a number of others have foundered through coming in contact with mines or as a result of bombing and shell fire. Whatever be the cause, it must be realised that there is an enormous volume of submerged wreckage in the vicinity of many port entrances which constitutes a serious menace to navigation.

The necessity of removing these obstructions is clearly obvious and the work must be done without delay. In the case of British ports the responsibility devolves on the local harbour authority which is statutorily empowered and enjoined to remove all wreckage in and about the vicinity of its port entrance. But the cost involved is oftentimes so considerable that the Dock and Harbour Authorities' Association has felt constrained to address a memorial to H.M. Government pointing out the inequity of leaving the port authority to face the problem which is really one of national concern. The memorial instances the case of the *Baron Vernon* sunk in the Clyde, the removal of which cost over £40,000, and of the *Brabo* sunk in the Tyne, in respect of which the latest estimate of the cost likely to be incurred is £200,000. Our readers will agree that expenditure of this order lays an inordinate burden on the port authority. Nominally, of course, the latter may have in certain cases a right to look to the owner of the ship for reimbursement, but only too often the ship-owner himself would be quite unable to meet a bill of such magnitude and if he chooses to default, the port authority is left with merely the value of the recovered material which may be quite insufficient to set off against their outlay.

There are other grounds (foreign ownership for instance) which render recovery of expenditure difficult and even impossible. Hence the Association justifiably makes an appeal to the Government to treat the whole matter as a national liability and to shoulder the obligation for "the lighting and marking of all wrecks lying in or near the approaches of any Harbours or Conservancy Authority, and for the removal or dispersal of such wrecks."

The contention of the Association is so well-founded that it is a pity the Government appear to be dilatory in coming to a decision. They have had the matter under consideration since last February, and as we have pointed out above, the work must be put in hand at once to enable British ports to function normally.

Impact Stresses in Jetties.

The article on the above subject, by Mr. Garde-Hansen, a first instalment of which appears in this issue, deals with a matter of the highest importance to engineers who are responsible for the design of jetties, wharves and piers, whether of open work or as solid structures, though it is to the former class that the problem chiefly applies. Solid structures of masonry and concrete can generally be relied on to offer effective resistance to impact by the sheer inertia of their mass, so that any ill effects are more likely to be felt by the colliding body, that is, the vessel, than by the stationary object collided with. In open framework, on the other hand, whether it be of timber or reinforced concrete, certain definite, though ill-defined, stresses are set up in the component parts of the structure, and it is the determination of the amount and character of these stresses which constitutes the crux of the problem.

Unfortunately, the data available are vague and incomplete. Impact may take place under a wide range of conditions, varying from head-on collision at high speed to a glancing blow of small amount at an extremely acute angle. Obviously a good deal has to be assumed, both as regards the speed of the colliding vessel and the angle at which the blow is delivered, which latter may have the effect of spreading the impact over a more or less extensive area.

Mr. Garde-Hansen makes an elaborate and painstaking investigation of the potential conditions and then proceeds with a mathematical analysis, which, while extremely valuable from a theoretical point of view, none the less requires a substantial application of that much abused term, "the factor of safety," in order to produce any feeling of confidence in the result. This observation does not imply any reflection on Mr. Garde-Hansen's calculations; it is inherent in the case and is due to the wide range of postulates which have to be conceded in order that the problem may be tackled in any systematic sense at all.

We leave our readers to follow Mr. Garde-Hansen's arguments and deductions, feeling sure that the cogency of the reasoning cannot but be productive of good, while, at the same time, we cordially endorse his appeal to port authorities and engineers to endeavour to obtain by practical observation and measurement, data which will serve to determine with a greater degree of accuracy than is at present available, the distribution of the kinetic energy in collisions between moving vessels and jetty structures.

Registration of London Port Workers.

To any one who is at pains to read the detailed Report of the Work of the Port of London Registration Committee during the years 1940 to 1944, which has recently been published and appears in this issue, it will be abundantly clear that the enrolment and supervision of the labour resources of the Port of London is a very complex and intricate business. Normally the Committee were in the habit of issuing a report on their work at the end of each successive year but on account of the war this practice had to be discontinued at the commencement of 1940. The present report, therefore, covers the period of five years to 31st December, 1944, and the summary of the number of men included in the "Live Register" at the end of each calendar year is convincing evidence of the great war time fluctuation of quayside employment at the Port of London. In 1939 the number was 31,971. In the following year it dropped to 13,019. Then, somewhat irregularly, it increased by degrees to 19,013 in 1944. The causes which led to the decrease in 1940 were the diversion of shipping to other ports and the destructive results of enemy action—lack of work led many of the dockers to seek and obtain employment in other directions, while others were absorbed in the fighting services. Later, there was a drift back to the industry of numbers of men who had temporarily left it.

The Committee can rest assured that their services have been of great value to the Port and the claim justified that their preparatory work has enabled the Dock Labour Scheme to be introduced into London with the minimum of difficulty and delay.

The London Docks Labour Dispute.

We devoted a considerable amount of space last month to a discussion of the causes and development of the labour dispute at the docks of the Port of London, commonly referred to as the "Go-Slow" strike. The matter was still unsettled when we went to press, though a decision seemed imminent. However, as matters have turned out, it cannot be said that any very definite conclusion of the matter has been realised. A point was reached at which over 1,000 men were returned to the Pool for disciplinary action, with the result that sentence of 14 days suspension was passed, by which the men lost the right to 6 shillings half-day attendance money, when no work was forthcoming. An appeal made by 50 of their number to the Appeals Panel of the Dock Labour Corporation was dismissed on August 22nd. Since then, up to the time of writing, there has been no further development to record.

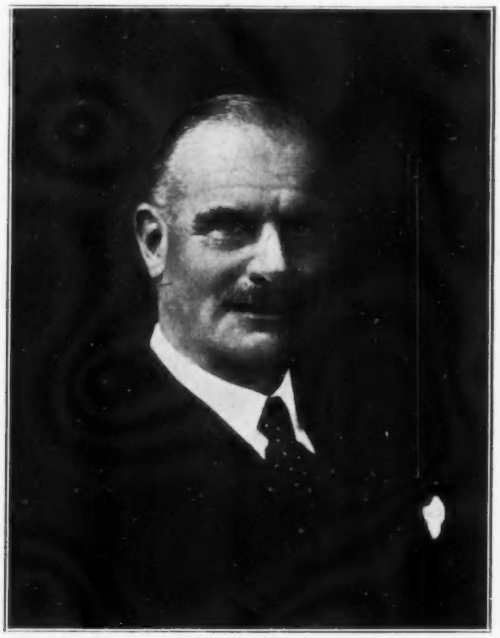
Meanwhile, following a mass meeting of the men concerned on August 13th, there was a general return to work, so that it would appear that the whole trouble, which lasted more than ten weeks, has gradually subsided. The net result is that nothing has been gained by the malcontents, while the trade of the Port has suffered to a very considerable extent. The folly of such movements is obvious, but so long as dock workers allow themselves to be influenced by hot-headed agitators, their cause will gain no credit or sympathy from the general public, who are the ultimate sufferers from such ill-considered action.

Ardrossan Harbour

A Thriving South-West Scottish Port

By H. HOPPERTON, J.P., M.Inst.T., Director-in-charge

AMONGST the smaller ports of the country, Ardrossan, in the Firth of Clyde, on the West Coast of Scotland, has responded throughout the war to the extraordinary demands on its transport facilities in loading and discharging ships carrying essential war materials, and the rate of despatch has frequently exceeded the expectations of the Ministries concerned. Contributory to this effort is undoubtedly the modern equipment and the control of the stevedoring organisation by the management of the Port Authority. One of the very few honours awarded by His Majesty for port transport services was granted to an Ardrossan docker.



Sir ALFRED H. READ
Chairman of Coast Lines, Ltd., and of the Ardrossan Harbour Company

Administration and History

The Port of Ardrossan is governed by a Statutory Authority incorporated in 1886 in the name of the Ardrossan Harbour Company, although the Port dates from 1805, in which year the Old Dock and Breakwater Piers were completed by the Earl of Eglinton. The Statutory Authority completed the Eglinton Dock and the Eglinton Tidal Basin in 1892 and an Ocean Tanker Oil Berth in 1930.

Dock Accommodation

Particulars of the dock accommodation, tidal and impounded, at the port are as follows:

The Eglinton Dock has an enclosed area of 9¾ acres, with an entrance width at floor level of 54-ft., and a depth of water over sill of about 28-ft. at H.W.O.S.T. The Eglinton Tidal Basin is 180-ft. wide and has an internal depth of water of 18-ft. at low water spring tides. The tidal rise at the port is 10-ft. at springs and 8-ft. at neaps.

The Old Dock, of 4 acres area, has an entrance 57-ft. wide, with 19-ft. depth of water at H.W.O.S.T. It is now reserved for ship-repairing operations and it has a fitting-out basin.

There is also a dry dock capable of receiving vessels up to 336-ft. in length and 46.3-ft. beam, with 16-ft. of water over sill at ordinary high water. It is leased to the Ardrossan Dockyard, Ltd.

Trade of the Port

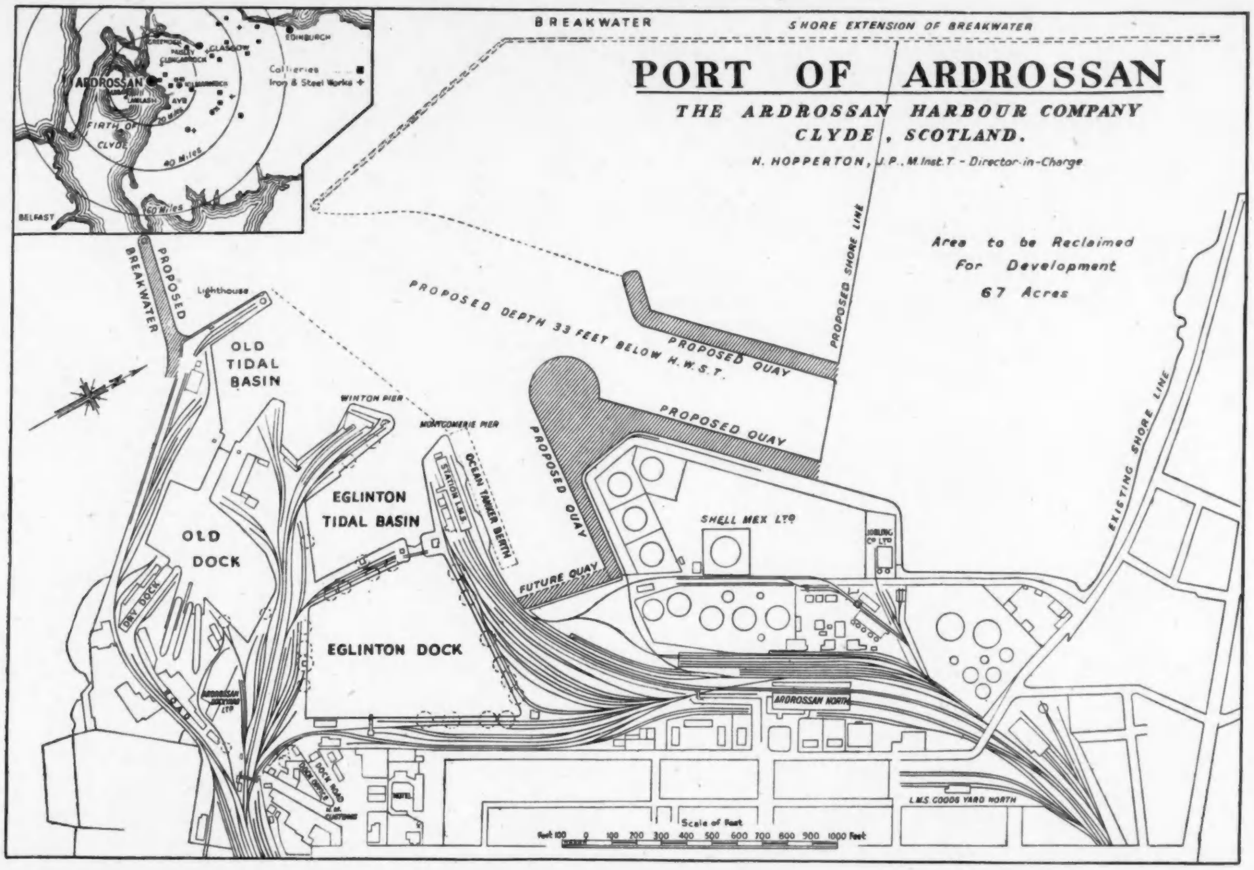
The principal traffics are raw materials for the iron and steel works, oil and petroleum, general cargo trade between Ardrossan and Belfast, and there is an extensive passenger business with the Isle of Man, Belfast, Arran and the Western Isles. The estimated number of passengers during a peace time year reached over 500,000.

The port includes two main line railway stations alongside which passenger vessels berth irrespective of tide. The L.M.S. Railway Company provide railway service, the sidings within the harbour accommodating 1,800 wagons.

Ex-Provost HARRY HOPPERTON, J.P., M.Inst.T.

The quays are electrically lit and are equipped with modern discharging and loading cranes, wagon movements alongside ship being made by electric and hydraulic capstans. Since 1939, eight new electric cranes of 5-ton capacity with luffing movement fitted for working with discharging grabs, including special "Octopus" grabs for handling scrap steel, one of which is illustrated on the next page, have been installed. The total equipment of cranes numbers 27, with a lifting capacity up to 40 tons.

The Port Authority carry out the general stevedoring in the port, the labour being organised by the National Dock Labour Corporation under the Essential Works Order.



Aerial View of Harbour

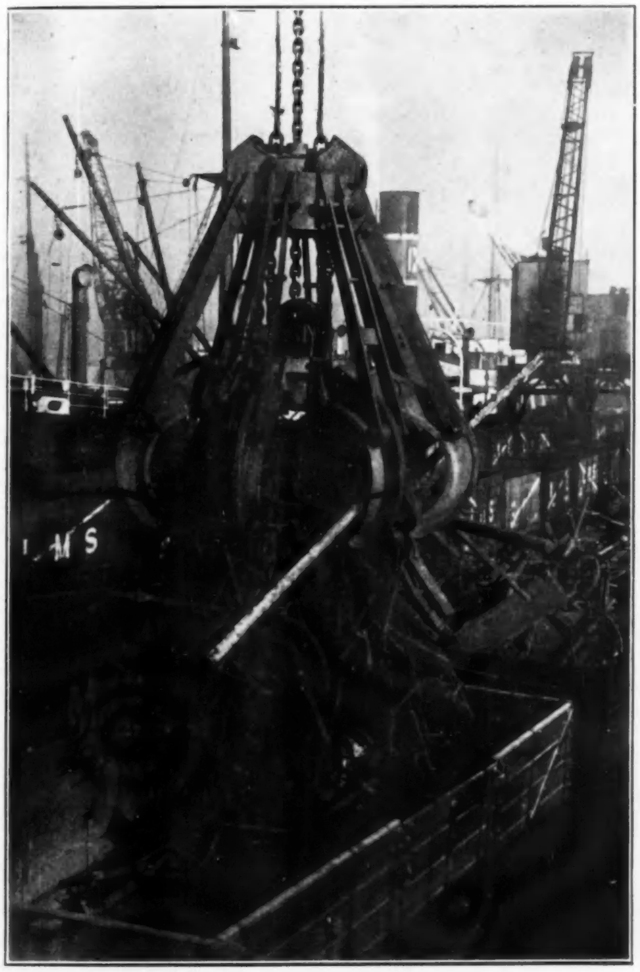
Ardrossan Harbour—continued

The Port Authority provide a well-found tug for assisting in docking vessels, and other Clyde tugs are readily available.

Included in the area of the port are substantial industries, including a Refinery and Bitumen Plant of the Shell Company, with very extensive storage capacity. There is a Government factory for filling petrol and oil, an Oilskin Factory and other small concerns.

Oil bunkers to the specification of shipowners are available at a number of dock quays, direct ex. pipeline and heated mixing tanks.

The port is four miles from one of the largest chemical factories in the world, eight miles from the large steel works at Glengarnock owned by Colvilles, Limited, nine miles from Prestwick Aerodrome, 12 miles from Kilmarnock, 20 miles from Paisley, and 30 miles from Glasgow.



Grab for Handling Scrap Steel

The volume of traffic may be summarised for the years 1922 and 1939:—

Year	Cargo Tons	Vessels N.R.T.
1922	445,285	733,324
1939	806,109	998,660

The port has been used by the Admiralty during the war years as a minesweeping base and for berthing, building and repairing naval vessels.

The Harbour Company

The public have invested £400,000 in the Ardrossan Harbour Company, for which they obtain a return of $4\frac{1}{2}$% per annum.

The Ardrossan Harbour Company's Directors are representative of important shipping, shipbuilding, engineers and iron and steel manufacturers. The Chairman is Sir Alfred Read, of Coast Lines, Limited; the Vice-chairman, Sir John Craig, of Messrs. Colvilles, Limited; Mr. Harry Hopperton, Director in Charge;

Quay Crane at work

and the other Directors are Mr. Randal G. Kincaid, of Greenock, and Captain A. R. S. Nutting.

The Directors act as Commissioners for the Ardrossan Pilotage Area.

General Observations

The Firth of Clyde contains many fine anchorages, one of the finest at Lamlash being within the Customs Port of Ardrossan.

The port is prepared to encourage the development of an increased fishing industry and a fleet of fishing trawlers, as well as herring carriers. The Trade will be interested in the convenience of Ardrossan as a distributing centre when the zoning schemes of the Food Control are again related to practical requirements.

Projected Developments

The plan of the harbour on the previous page shows, in addition to the existing accommodation at the port, certain provisional lines of development, providing for an additional breakwater on the south side of the harbour, together with deep water berthage for ocean oil tankers and large cargo vessels The objective depth for this and the approach to the berths is 33-ft.

The proposals have been submitted in general terms to the Committee presided over by Lord Cooper and are subject to the approval of the Minister of War Transport.

Port of London Registration Committee

Report of the Work of the Committee during the Years 1940 to 1944

The Committee normally issued a report on their work at the end of each year. This practice was temporarily discontinued in 1940. This report therefore covers the main activities of the Committee during the five years, 1st January, 1940, to 31st December, 1944.

Membership of the Committee

The constitution of the committee has not been varied, but there has been a number of changes in the personnel. Mr. T. W. Condon, O.B.E., Joint Chairman, was granted leave of absence in 1940, to take up an appointment under the Ministry of Labour and National Service, as Regional Port Inspector for No. 2 Region (an area covering London, South Eastern, South Western, Welsh, and certain East Anglian Ports), and later as Deputy Port Manager of The National Dock Labour Corporation, Ltd., in London. On relinquishing the latter post, Mr. Condon resumed his position as Joint Chairman of the Committee in 1943. During his temporary absence, Mr. D. W. Large, of the Transport and General Workers' Union, acted as Joint Chairman.

Mr. W. L. Wrightson, O.B.E., who had been Joint Chairman of the Committee since 1931, found it necessary for health reasons, to give up some of his port activities, and in consequence he resigned in 1943. He had been a member of the Committee since 1925. The Committee and the industry are indebted to him for very valuable services rendered in connection with the development of Registration Schemes, particularly in London. He has been succeeded as Joint Chairman by Mr. R. H. S. Woodgate, one of the representatives on the Committee of the London Association of Public Wharfingers, Ltd.

On the Employers' side, Messrs. L. H. Bolton, J. K. Swire, W. E. Keville and W. H. Venner have, for varying reasons, resigned.

On the Trade Union side, Messrs. J. Boswell, J. T. Scoulding, J.P., H. Rogers, and W. M. Turner are no longer serving as members of the Committee.

The present constitution and membership is given at the end of this report.

Live Register of Port Transport Workers

The number of men included in the Live Register at the end of each Calendar Year 1939 to 1944 was:

1939	...	31,971
1940	...	13,019
1941	...	15,598
1942	...	16,516
1943	...	17,896
1944	...	19,013

During 1940 the diversion of ships to other ports and enemy action in London, had considerable effect on the employment position of the London dock labour force. Because of under-employment, many men sought and obtained employment in other industries. Many of them failed to inform the Committee that they had temporarily left the industry. The available statistics of the number of men at work together with the number proving unemployment showed that there remained each day some 12,000 men unaccounted against the recorded nominal strength. A census was therefore taken and on a given day, all employers reporting the Port Registration numbers of men employed by them on that day. Additionally, by arrangement with the Ministry of Labour and National Service, the Committee were provided with the Port Registration numbers of all men proving unemployment on that day. By this means a more accurate figure of the dock labour force available was obtained. All men not accounted for on that day were communicated with and those found to be serving in H.M. Forces, employed in other industries, etc., were transferred to a "Dormant" Register. By the end of December, 1940, it was established that the dock labour force available was approximately 13,000 men.

In 1941 there was a gradual drift back to the industry of numbers of the men who had temporarily left it. This was no doubt due, in part, to the issue in September, 1941, of the Essential Work (Dock Labour) Order, 1941. Additionally, the Committee under the terms of this Order, brought within the Registration Scheme certain classes of Port worker not hitherto included, resulting in a further increase in the Live Register, which at the end of 1941 comprised some 15,500 men.

The London Dock Labour Scheme came into operation on Monday, 16th March, 1942. Under this Scheme, the size of the Live Register is decided by the London Board of the National Dock Labour Corporation, Ltd., after consultation with the Port Emergency Committee. The Register was fixed at 18,176 men, allowance being made for new classes of workers not hitherto included in the Scheme. Actually, the labour force did not reach this figure at any time during 1942. The amount of employment available was not sufficient to utilise the whole of the men available, with the result that many men were receiving no more than the authorised Attendance money under the Scheme. Numbers therefore sought and were allowed to obtain more lucrative employment in other industries. Because of the employment position it was unnecessary to bring the Register up to its agreed authorised maximum. Moreover, wastage was not replaced, and in the result, the Register at the end of 1942 was only 16,516 or under 1,000 in excess of the figure at the end of the previous year.

In January, 1943, it was decided by the National Dock Labour Corporation, Ltd., to reduce the number of men on the Live Register by 1,500. This decision was made because there was insufficient work available for the number of men on the Register, and there were several thousand men surplus to requirements. Effect was not, however, given to this decision for several reasons, not the least of which was that the employment position began to improve and within a few months authority was given to bring the Register up to its agreed maximum. This was accomplished by the re-admission to the Register of a fairly large number of men from the "Dormant" Register who were awaiting re-entry to the "Live" Register pending the issue of authority for an increased register. In August, 1943, shortages of labour were recurring and the Committee were therefore asked to provide 400 more men. This number was obtained by the recall of Registered men from other industries. A further increase of 890 men was authorised in October, 1943, and at the end of the year the Live Register had been increased to 17,896 men.

Early in 1944 two further increases in the Register was authorised and a ceiling of 18,950 men was fixed. Here again, the Committee were able to provide the number of men required mainly by the recall of Registered men on the "Dormant" Register but because these men were not becoming available so readily as previously, owing to the shortage of labour in other industries, it became necessary to recruit men who had not previously been registered. These men were admitted to a Supplementary Register created solely to provide for short term engagement. The position of these men is referred to in more detail in a subsequent paragraph of this report. In September, 1944, a further increase of 500 men was authorised to bring the Register up to a maximum of 19,450. While the intake of these men was proceeding, notification was received that recruitment should be discontinued and that the Register should be allowed, by wastage, to reduce to 18,950 men, the ceiling figure prior to the last recruitment. In November, 1944, authority was given to reduce the Register by some 300 men forthwith instead of by wastage alone. This was effected by the termination, on grounds of redundancy, of the services of 300 men on the Supplementary Register. Authority was also given in December, 1944, for a further reduction in the Register of 100 men, but this was not proceeded with in view of the shortage of labour then existing. On the 31st December, 1944, the Live Register figure was 19,013.

Dock Labour (Compulsory Registration) Order, 1940

The Registration Scheme was operated on a voluntary basis from 1920 until June, 1940, when the Dock Labour (Compulsory Registration) Order was issued. This Order provided that an employer should not engage men for work, and men should not work, other than in accordance with the provisions of the Registration Scheme. It followed that the existing Registration Scheme

Port of London Registration Committee—continued

would require considerable amendment to operate the compulsory method, and the Committee were required to prepare an amended Scheme for approval by the Minister of Labour and National Service. It was necessary to provide a definition of the term "Port Transport Work," to examine the position of all employers in the Port to determine their eligibility for inclusion in the Scheme under the revised definition, to continue to provide a suitable token of registration for men included in the Register of Port Workers, which would also contain evidence of employment, to supervise call places and to ensure that as far as possible employment was confined to Registered men. The new Scheme came into operation on 25th July, 1940.

To conform to the requirements of the Order, the Committee evolved a combined registration token and employment record book. The token to serve as evidence of registration, and the record book to secure an accurate record of work obtained by the individual port worker. The introduction of a work record had been agreed in principle by the Industry several years previously but had not hitherto been operated.

To operate the new method, numbered rubber stamps were issued to all employers who were required to stamp the record book of all men, on engagement. Similarly, the book was stamped at Port Workers' Offices when men had not secured engagement and were proving unemployment. The Committee were therefore enabled to secure a more complete record of the men. The new record book was issued at the annual exchange of registration books in July, 1941, and became operative from then.

The Committee also had to examine the position of some 300 employers, mainly Waterside Manufacturers, Wharfingers, the firms engaged in the Lighterage Trade, not hitherto included in the Scheme, to determine whether they were appropriate for inclusion in view of the new position. This was a lengthy process and involved the Committee in a very considerable amount of work which was not completed until after July, 1941. At that date some 75 employers were scheduled for inclusion in the Scheme and 150 (mostly Waterside Manufacturers) for exclusion. The remainder were placed in a "Suspense" Register, as they were not then operating or were still in negotiation with the Committee, either because of the consideration of objection to inclusion, or because it was known that the introduction of an Essential Work Order for the Industry was contemplated, and that further revision of the Registration Scheme would be necessary. All the work undertaken by the Committee as the outcome of the Dock Labour (Compulsory Registration) Order was a necessary preliminary in preparation for subsequent legislation for the Industry.

Essential Work (Dock Labour) Order, 1941

The issue of this Order in September, 1941, introduced to the Industry the National Dock Labour Corporation, Ltd., and Dock Labour Schemes. Both are now very well known. So far as the Committee is concerned, it involved them in the greatest amount of preparation and negotiation that they had to undertake since the inception of the Registration Scheme in 1920.

Before the Dock Labour Scheme for London could be submitted to the Minister of Labour and National Service, the Committee were required to review their definition of "Port Transport Work," to define the "limits of the Port," and to review the position of employers and work people. The introduction of the money element necessitated the most careful consideration of these problems in order to preserve just and equitable administration.

What was then thought to be a satisfactory definition of "Port Transport Work" was evolved after consultation with Port interests and accepted for inclusion in both the Registration and Dock Labour Schemes. In like manner the limits of the Port area were defined. It is of interest to note that these had never previously been defined under the Registration Scheme.

In reviewing the position of employers and work people it was found necessary to include in the Scheme certain classes of labour not hitherto included. Among the classes of worker so included were Tug Masters, Mates and Deck-hands, Up-town Cold Air Stores men, Rough Goods Lighterage hands, Canal hands, and certain grades of labour at Coal Hoists.

On the administrative side of the whole of the Register of Port Workers was re-numbered and a new form of registration token was provided. To provide for the allocation of employers and employees to the Port Sectors in which, in the case of the former, they normally operated, and in the latter case in which they elected to be allocated, notices and forms of application were sent to some 700 employers and 16,500 men.

The London Dock Labour Scheme commenced on the 16th March, 1942. Several of the functions formerly undertaken by the Committee were transferred to the London Dock Labour Board, and for practical purposes the duties of the Committee were then and have since been confined to maintaining the Registers of Port Employers and Employees. It can be said that had it not been for the many years of preparatory work undertaken by the Committee it would not have been possible to introduce the Dock Labour Scheme in London with the speed and facility with which it was actually done. In many ways the new Scheme is based on principles evolved and carried through by the Committee, and as it embodies provisions which entail the decasualisation of the Port Transport Industry in London, it can be said also that in principle it represents the fruition of the Committee's efforts in this respect over a period of 22 years.

National (Dock Labour) Transfer Scheme

Owing to the diversion of shipping, ports have been called upon, at short notice, to handle additional shipping with the result that the local labour force has been insufficient to meet the demand. To meet emergencies of this kind, arrangements were made for the temporary transfer of dockers from other ports, a most satisfactory arrangement, as it is obviously best to utilise the services of the experienced docker at the job he understands rather than to make use of inexperienced labour. In November, 1939, a Scheme was evolved by the National Joint Council for Dock Labour and the Ministry of Labour and National Service to give effect to this arrangement. Men so transferred do not incur any personal expense so far as the actual transfer is concerned, as all travelling costs to the requisitioning port are paid and subsistence allowance, etc, are also paid. In the light of experience gained in the administration of the Scheme, there have been several subsequent amendments to it. In London, the Scheme was first operated in June, 1940, under the aegis of the Local Joint Committee and Registration Committee. Later, on the appointment of the Regional Port Labour Inspectorate, the main functions were transferred to this body. With the introduction of the London Dock Labour Scheme, the National Dock Labour Corporation, Ltd., assumed responsibility for transfer which then ceased to be on a voluntary basis. Throughout the three phases, the Registration Committee and its staff have been connected with the operation of the Scheme.

Because of lack of sufficient employment in the Port, London was at the outset, and until 1943, one of the principal supplying Ports. Since the improvement in the employment position in London in 1943, the number of men transferred to other ports has been small. Altogether, some 25,818 London men have been transferred away since June, 1940. The following information shows the number of men transferred to the respective ports indicated:

Locality	No. of Men Transferred
Cardiff	4,307
Bristol	3,218
Manchester	3,214
Liverpool	3,150
Glasgow	2,204
Swansea	2,096
Southampton	1,352
Newport	1,329
Grimsby	793
Hull	697
Barry	438
Newcastle	379
Stockton	238
Gloucester	216
Rochester	206

Port of London Registration Committee—continued

Morecambe	154
Middlesbrough	148
Barrow	140
Boston	135
Greenock	123
Plymouth	103
Dundee	94
Sunderland	71
Fleetwood	49
Leith	13
Wisbech	10
Total	25,231

Some 587 men have also been transferred, under the Scheme, to other parts of the country to undertake work other than dock work, as follows:

Locality	No. of Men Transferred
Edinburgh	110
Slough	80
Sheffield	51
Cockermouth	50
Maidstone	50
Liskeard	48
Great Bridge	30
Denbigh	25
Coventry	16
Birmingham	16
Coatbridge	15
Oldbury	15
Runcorn	15
Oxford	13
Mold	12
West Bromwich	12
Wednesbury	10
Wolverhampton	10
West Drayton	7
Girvan	2
Total	587

It should be understood that in the main, the men have been transferred for limited periods (e.g., to discharge a convoy) and returned to London on completion of the work. There is, however, a small number of men who have been on transfer for a long period. At the end of 1944 there were only 511 men away on transfer.

Recruitment to the Register

There has been no general recruitment to the Register since the war started, so far as new entrants are concerned. The reasons for this are that from the start of the war until 1943, the available labour force was always in excess of requirements. Additionally, there are at present some 10,000 registered men at present serving in H.M. Forces or temporarily employed in other industries who will expect to return to port work when the war ends. The Committee are under an obligation to the majority of these men to re-admit them to the Live Register. They cannot therefore incur further liability until the claims of the men on the "Dormant" Register have been met. There is the further point that if the principles of the London Dock Labour Scheme are continued after the war, it is reasonable to assume that a less number of men will be required to operate the Port than was necessary under the voluntary Registration Scheme operating in 1939.

Supplementary Register of Port Workers

Whenever it has been necessary to increase the labour force, it has been the policy of the Committee to give preference in re-entry to men on the "Dormant" Register working in other industries. Wherever possible, these men have, by arrangement with the Ministry of Labour and National Service, been recalled to their normal work. This has had the advantage that experienced men resume work in their own industry, and it also reduces the number of men on the "Dormant" Register, and so reduces the liability the Committee are faced with in this connection.

The Supplementary Register has been instituted solely for the purpose of meeting temporary labour requirements of the port. Men admitted to this Register have the same conditions and privileges as men on the Main Register, but their retention on the Live Register is entirely dependent upon the needs of the port, and their services may be terminated so soon as the volume of work in the port is reduced.

"Dormant" Register

The "Dormant" Register contains the names of all men who have been allowed to leave the "Live" Register for varying reasons but who expect to resume their normal occupation when circumstances permit. This Register comprised some 17,000 men in 1940, but has been reduced to its present figure by the recall of certain of the men from other indusries and by wastage (e.g., death, retirement, etc.).

The number of men on the Register at the end of 1944, was 9,996. For administrative convenience, the men are divided into the following classes:—

	No. of Men
(a) Serving in H.M. Armed Forces	4,345
(b) Serving in Merchant Navy	713
(c) Serving in Civil Defence Units	276
(d) Temporarily employed in other branches of this industry, or in other industries	1,905
(e) Long Term Sick and Accident cases (men continuously absent from work for 16 weeks or more)	567
(f) Not traceable	2,190
Total	9,996

Of the 2,190 men not traced, contact has been lost with them because letters sent to their last known address have been returned by the Postal authorities as undeliverable. In many cases the premises have been demolished, and the men may therefore have become casualties. Additionally, numbers of the men are of military service age, and may therefore be serving in H.M. Forces.

Reinstatement in Civil Employment Act, 1944

This Act which came into operation on 1st August, 1944, lays an obligation on employers to take into their employment former employees who, as far as the Port Transport industry is concerned, joined H.M. Armed Forces after 25th May, 1939, or who, after 10th April, 1941, became a whole-time servant in a Civil Defence Organisation in consequence of an enrolment notice. The obligation on the former employer is subject to the condition that reinstatement is reasonable and practicable. The National Dock Labour Corporation, Ltd., is regarded as the "former employer" for the purpose of the Act in dealing with the pre-war casual registered dock worker who claims rights under this Act. The individual pre-enlistment employer has the right of dealing with applications from men claiming rights under the Act, who were weekly workers prior to enlistment. These points are covered in the Essential Work (Dock Labour) Orders, 1944 and 1945.

It is estimated that there are approximately 4,500 registered Port Workers in London who are eligible to claim reinstatement rights under this Act. There is, however, additionally, a number of men who followed this industry prior to the war as unregistered Port Workers, some of whom will doubtless endeavour to establish rights under the Act. While therefore it may be the intention of the industry to give the greatest possible consideration to the claims of the registered and non-registered Port Worker, it may be that they will have regard to the question whether it is reasonable and practicable to absorb all these men, if they are also to have regard to the actual labour requirements of the Port.

Age Analysis of the Live Register of Port Workers

The following analysis of Age Groups of the 19,013 men included in the Live Register at the end of 1944, shows that, in

Port of London Registration Committee—continued

common with other industries, the labour force is mainly composed of elderly men:—

Age Group	No. of Men	Percentage of Live Register
Under 30	551	3.0
30-34	935	4.9
35-39	2,284	12.0
40-44	2,932	15.4
45-49	2,791	14.7
50-54	2,878	15.1
55-59	2,746	14.4
60-64	2,279	12.0
65 & Over ...	1,617	8.5
	19,013	

Enquiry into the Application of the Dock Labour Scheme to Cold Storage Undertakings

In their negotiations with the majority of individual employers on the question of inclusion or exclusion from the scope of Registration, the Committee were able to secure acceptance of the position which arose following the issue of the Essential Work (Dock Labour) Order, 1941. Certain Cold Storage Undertakings not hitherto included in the Scheme, however, raised serious objection, and in view of the importance of the issues involved, the Minister of Labour and National Service appointed Sir John Forster to hold an enquiry. This took place in April, 1943, and lasted three days.

The Committee had sought, for adequate reasons, to include in the Scheme 24 of these Cold Stores. As a result of the enquiry it was decided that 17 of the Stores should be included. The remainder were excluded.

Register of Supervisory Grades

Under the revised Registration Scheme supervisory grades are not registered as port workers, but the Committee have continued to make provision for this class of worker and maintain a Register of Supervisory Grades of men notified by employers as employed in a supervisory capacity. This follows the practice adopted by the Committee under the voluntary method when a Schedule II Certificate was issued to a man admitted to this register. The issue of a Schedule II Certificate has been discontinued and men are now "listed." The object is to safeguard the position of these men so that if and when employment in a Supervisory capacity terminates, consideration can be given to an application for entry to the Live Register as a registered port worker.

Disciplinary Cases

Until the introduction of the Dock Labour Scheme in 1942, the Committee undertook the responsibility of dealing with all cases of men reported to them for misdemeanour or unsatisfactory conduct. A Joint Sub-Committee summoned the men before them and dealt with them in the light of the circumstances of the individual case, imposing a period of suspension, cancellation of registration or issuing a warning according to the seriousness of the offence. On the advent of the Dock Labour Scheme, these functions were transferred to the Port Manager of the National Dock Labour Corporation, Ltd., and the Committee ceased to deal with this matter.

Office of the Committee

The Office of the Committee in Tower Bridge Road, S.E.1, was partially destroyed by enemy action in May, 1941, and was transferred to the present address shortly afterwards. Although there was loss of a number of records, the whole of the Registers of Port Workers were salvaged and the Committee have therefore a complete record of all the men included in the Registers at the start of the war.

Constitution and Present Membership

Mr. T. W. Condon, O.B.E., and Mr. R. H. S. Woodgate are Joint Chairmen of the Committee.

Employers.

Port of London Authority
Mr. A. K. Graham.

London Shipowners' Dock Labour.
Mr. M. F. G. Sandes Magill.

The London Association of Public Wharfingers, Ltd.
Mr. R. H. S. Woodgate.
Mr. S. R. Lewis.

The Association of Master Lightermen & Barge Owners.
Mr. C. T. Braithwaite.

The London Master Stevedores' Association, Ltd.
Mr. C. F. Smith.

The London Short Sea Traders' Association.
Mr. C. A. Carr.

Trade Unions.

Transport & General Workers' Union.
Mr. T. W. Condon, O.B.E.
Mr. T. O'Leary.
Mr. D. W. Lodge.
Mr. P. Dunn.

National Amalgamated Stevedores and Dockers.
Mr. R. Barrett.
Mr. A. J. Archer.

Watermen, Lightermen, Tugmen and Bargemen's Union.
Mr. R. Coombes.

Composition of the "Live" Register of Port Workers.

The Committee have continued to maintain the "Live" Register in four main classes as follows:—

	No. of Men on Register at 31/12/44
1. Ocean Shipowners' Tally Clerks (O.S.T.)	526
2. Lighterage Section (L. & B.)	2,583
3. Stevedores (S.)	1,953
4. All other registered dock workers	13,951
Total	19,013

The Register is also sub-divided as between Weekly Workers (5,703) and Allocated Workers (13,310) and again sub-divided into Sectors.

There are three categories of Port Workers, viz.:—

		No. of Men
Category A.	Full-duty men	16,983
Category B.	Men not available for transfer to other Ports	743
Category C.	Aged and light-duty men ...	1,287
	Total	19,013

All Weekly Workers are included in Category A, also all men (773) on the Supplementary Register are included in this category.

Conclusion

The Committee gratefully acknowledge the valuable assistance they have received from Port Employers and Trade Unions associated with the work of Port Registration.

In the rapid development of the work in the war years, the calls on them have necessarily increased, but they have invariably given whole-hearted co-operation and so eased the work of the Committee.

The Committee also wish to record their high appreciation of the excellent services rendered by their Secretary (Mr. Nicholson) and his staff. Their ability, courtesy and industry throughout this difficult period, merit the utmost praise.

T. W. CONLON.
R. H. S. WOODGATE,
Joint Chairmen.

A. L. NICHOLSON, Secretary.
Ibex House, Minories, E.C.3.
March, 1945.

Notes of the Month

Resignation of Port Director.

Mr. Lancelot E. Smith, managing director of Smith's Dock Company, Ltd., North Shields, has anounced his intention of retiring from the position at the end of the current month.

New Seamen's Hostel at Liverpool.

A new hostel for merchant seeamen has been opened at 22, Grove Park, Sefton Park Road, Liverpool by Mr. John W. Booth, chairman of the Liverpool Port Welfare Committee.

French Port Rehabilitation.

It is announced that the Port of La Rochelle is once more in active operation, while Lorient is practically completely restored. Dunkirk and St. Nazaire are expected to be in commission within a few months' time.

Mobile Kitchens for Dock Workers.

The County of Wellington, Ontario, Canada, have presented two mobile kitchens for the use of workers in the London docks. The kitchens were accepted by Sir Ion Hamilton Benn, Bart., C.B., D.S.O., on behalf of the Port of London Authority.

Resignation of Member of Port Authority.

Mr. D. W. Large who has for the past three years been a nominee on the Port of London Authority of the London County Council, has resigned and been succeeded by Mr. Geoffrey Hinton. The Authority have conveyed to Mr. Large their thanks for his services.

Galway Harbour Finances.

At a recent meeting of Galway Harbour Board, Mr. O. C. Copeland, vice-chairman, who presided, said that the Government of Eire had been approached to sanction an overdraft of £11,000 so that the Board could pay off its debts. One member thought that more time should be spent by the Board in discussing methods of obtaining more revenue. Some of the creditors were in need of the payment of old accounts.

Peterhead Harbour and the Herring Trade.

Enquiries are being made by Peterhead Town Council, Peterhead Harbour Trust and other local bodies to ascertain why local herring are not shipped from the Peterhead Harbour. At present barrelled herring from Peterhead are dispatched from Aberdeen and Fraserburgh, whither they are taken by road or rail. It is urged that Fraserburgh Harbour should have the business, in view of the local catching and that this would help to lessen the decline in harbour revenue which has been a feature of recent years.

Cunard-White Star, Ltd. : New Vessels.

In the report of the directors of Cunard-White Star, Ltd., an important ship-building replacement programme is formulated. Sir Percy Bates, in some notes to the shareholders, states that the Company has arranged, or is arranging, for the construction of two combined passenger and cargo ships, carrying perhaps 250 passengers, and for a passenger ship similar to the *Mauretania*. In all the new tonnage will amount approximately to 76,000 gross.

The " Queen Mary " at Southampton.

The Cunard-White Star liner, *Queen Mary*, was given a rousing welcome on her arrival on the 11th July at her home port at Southampton. She had been absent from her normal berth during the whole of the war period, having sailed a few days before the outbreak of hostilities under secret orders to United States of America. The vessel was officially welcomed on arrival by the Mayor, Councillor J. C. Dyas, in his capacity as Admiral of the Port and by a party of officials which included representatives of the Steamship Company, the Southern Railway and the Ministry of War Transport. There was an imposing procession up Southampton Water to the Ocean Dock, pleasure steamers running trips crowded with sightseers and bands playing on the quayside.

New Floating Dock for Portland, Ore.

The Port of Portland (Oregon, U.S.A.) Commission has placed an order for the construction of a 10,000-ton floating dock.

Closing of the Crinan Canal.

In consequence of damage done to one of the lock gates of the Crinan Canal at Cairnbaan, the Canal has been closed to traffic for an indefinite period.

New Turkish Seaport.

A new Turkish seaport is in course of construction at Eregli on the South Coast of the Black Sea. It is one of two being undertaken by the Turkish Government, the other being at Trebizond.

Clyde Navigation Trust.

Mr. Hector M'Neill, now Regional Port Director for Scotland, has resigned from his duties with the Clyde Navigation Trust on which he served as a representative of the Corporation of Glasgow. Mr. Alexander Munro has been nominated as his successor.

Development of Thurso Harbour.

The Harbour Trust of Thurso, Caithness, have formulated and submitted to the Development Commission a scheme for the improvement and development of the harbour and have applied for a grant of £60,000 to meet the cost of the Scheme.

New Moles at Portimao.

Two new breakwater moles are to be constructed at the harbour of Portimao on the Southern coast of Portugal to enable the harbour to receive larger steamers engaged in bringing tinplate for the local sardine industry and the export of tinned sardines, as well as of cork and fruit.

Proposed Free Port at Christiansand.

Proposals have been put forward by the local Commercial Association for the establishment of a free port area at Christiansand, at the entrance to Romsdal Fjord, Norway. The Norwegian State is being asked to share the cost with a company to be formed *ad hoc*, having a capital of 500,000 kr.

Salvage of " Mulberry " Blockship.

The first of the blockships used to form the harbour known as " Mulberry " on the Normandy Coast at Arromanches, has been raised from its bed on the shore and towed to the Clyde. The vessel, the *Parkland*, has been beached between Craigendoran and Ardmore Point, whence after removal of the sand ballast, she is to be refloated and towed to a Troon ship-breaking yard for breaking up.

Kirkcudbright Harbour.

The harbour at Kirkcudbright is so badly silted up with sand that vessels cannot berth, and before the position can be ameliorated, considerable dredging work will be required to be undertaken. The Town Council have applied unsuccessfully for the services of a dredger to clear the channel, and the matter has been taken up with Mr. Thomas Johnston, former Secretary of State for Scotland. Provost Brown has characterised the position as one of considerable urgency.

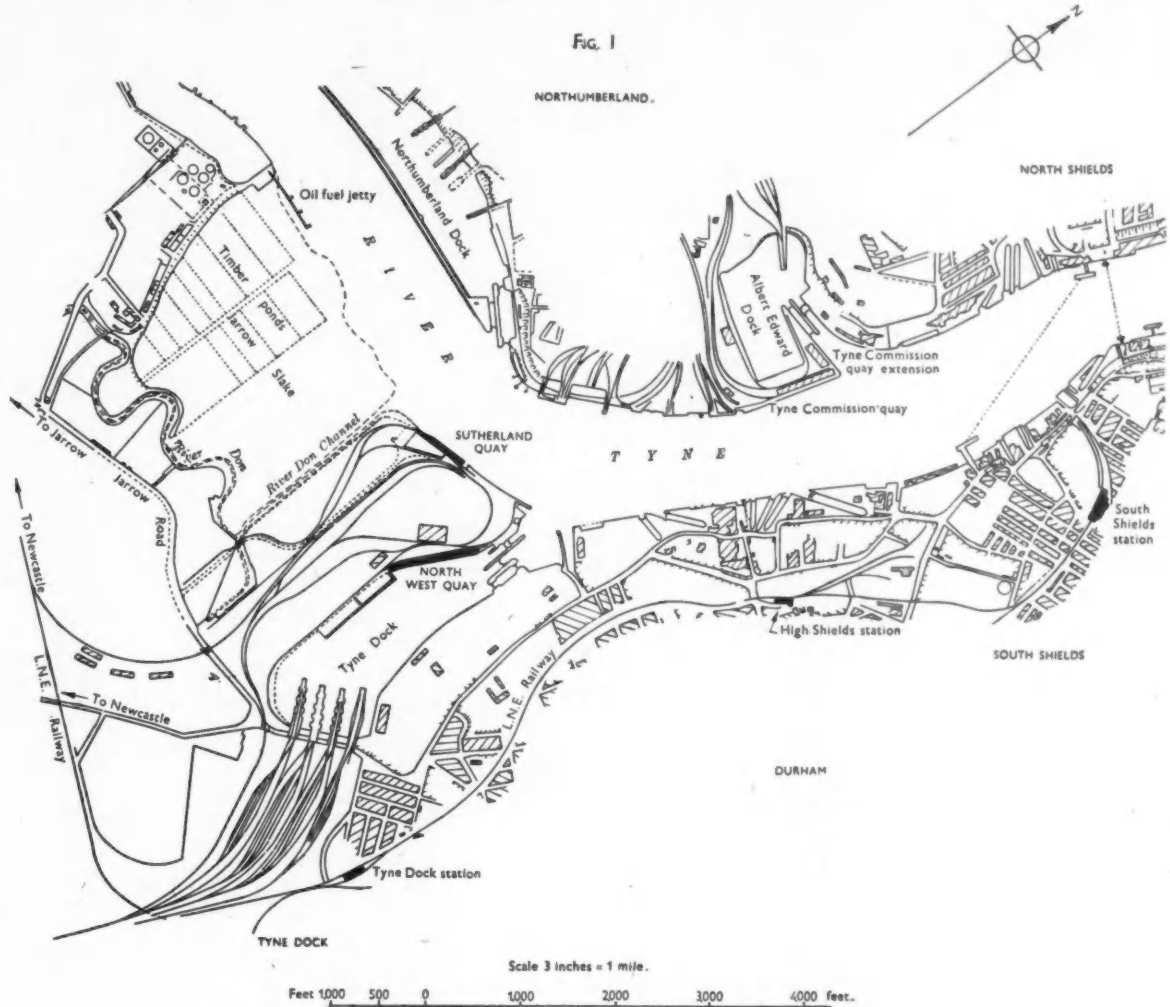
New Argentine River Authority.

Under the Ministry of Public Works in Argentina a new body, known as the River Transport Administration, has been formed to take over the units of the Department of Ports and Navigation operating in the Parana, Paraguay, Alto Parana and Uruguay Rivers. It is authorised to extend its jurisdiction to other rivers and navigable waters in the vicinity. The new administration is controlled by a Council consisting of the Director-General of Ports and Navigation, the Manager of the Transport Administration and the heads of the commercial, technical and accountancy departments.

Two New Quays at Tyne Dock, South Shields*

By ALFRED LAIRD HARVEY, M.C., B.A., M.Inst.C.E.

FIG. I



KEY PLAN.

Introduction

TYNE DOCK is situated on the south side of the River Tyne in the County Borough of South Shields, 3 miles from the Tyne entrance. It was opened in 1859, and, prior to the construction of the works described in this Paper, had a water area of 50 acres. Its construction was described by the late Mr. T. E. Harrison, M.Inst.C.E., Chief Engineer of the North Eastern Railway.

Originally the entrances consisted of a tidal entrance 80-ft. wide and a lock entrance 60-ft. wide and 315-ft. long. Both of these entrances had curved sills with a depth at the centre of the sill of 25-ft. 9-in. at High Water of Ordinary Spring Tides.

The lock entrance is still in use, but a new tidal entrance, 70-ft. wide, was constructed in 1894, with a curved sill having a depth in the centre of 34-ft. 6-in. The 80-ft. entrance, which lies between the lock entrance and the present tidal entrance, is no longer used and was closed off by means of a concrete dam in about 1923.

The gates of the tidal entrance are closed when the tide falls to 5-ft. below High Water of Ordinary Spring Tides (normal dock-level).

*Paper read at Maritime Engineering Division Meeting of the Institution of Civil Engineers 13th Feb., 1945. Reproduced by permission.

The depth of the main body of the dock is 30-ft. below normal dock-level, but the depths alongside the quays and coal staiths vary with the type of structure. The present dredged depth of the river between a point about 1 mile westward of the dock and the sea is 30-ft. at Low Water of Ordinary Spring Tides, the range of tide being 15-ft. on springs and about 11-ft. on neaps.

The dock and the adjoining property, including the partly reclaimed tidal flats of Jarrow Slake lying between the dock and the river Don channel, were acquired by the Tyne Improvement Commissioners in 1937 from the London and North Eastern Railway Company, the latter, however, retaining the right to use and work over an extensive group of sidings on the west side of the dock. Shortly afterwards a scheme was drawn up by the Commissioners for a new quay and sidings across the north-west corner of the dock, with an effective length of 800-ft., equipped with electric cranes, capstans, fresh-water supply, etc. The construction of this quay, known as the North-west quay, was begun in 1939 and is described in the first part of this paper.

In 1938 a further scheme, for the development of the river frontage to the west of the entrance to Tyne dock, was prepared, which provided for a reinforced concrete quay, 1,417-ft. long, at an estimated cost of about £700,000, with an ultimate dredged depth alongside of 35-ft. at Low Water of Ordinary Spring Tides

Two New Quays at Tyne Dock, South Shields—*continued*

and full facilities for handling general cargo and passenger traffic and iron ore.

The war intervened before tenders were invited and it was decided, at the end of 1940, to proceed instead with a modified scheme consisting of a timber quay, suitable for a vessel with a maximum length of 450-ft.

This quay, equipped for handling general cargo and provided with its own group of sidings, is situated at the west end of the river frontage. It is known as the Sutherland quay, and is described in the second part of the Paper.

Fig. 1 shows the location of both quays.

North-West Quay

General Description.—The quay accommodation along the west side when the Commissioners purchased the dock consisted of the Iron Ore quay, 1,000-ft. in length, built on the sloping bank of the dock, and a number of small pit-prop discharging jetties. All of these structures were in poor condition through age and on account of the badly worm-eaten state of the timber piling.

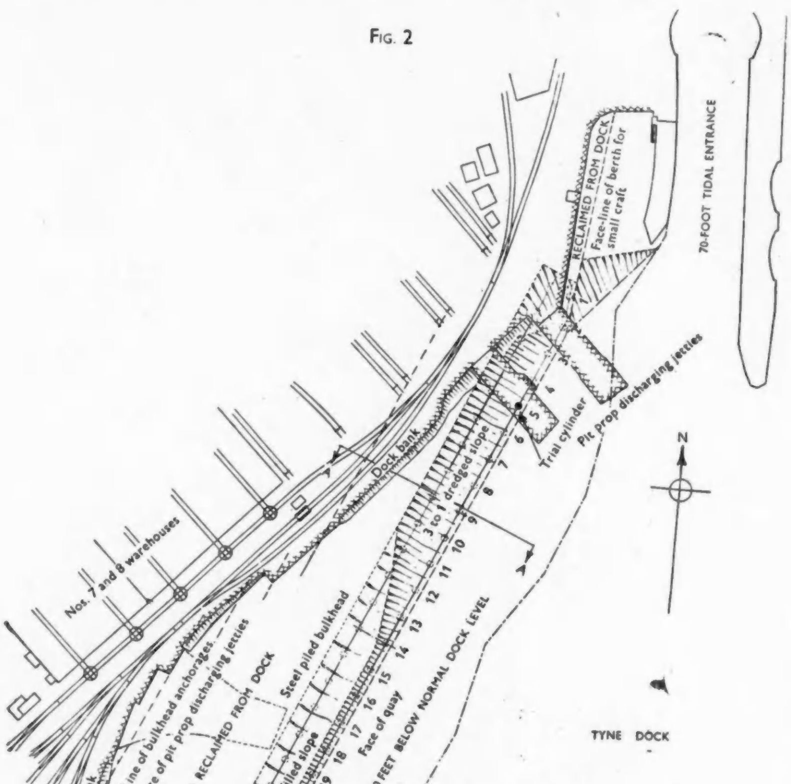
The new quay, which has a depth alongside of 30-ft. below normal dock-level, extends in a straight line from the back of the Iron Ore quay to the tidal entrance, where it terminates in a shallow berth for small craft just behind the entrance pier. The dock bank between these two points originally ran just in front of the railway, serving warehouses Nos. 7 and 8, and the area thus reclaimed from the dock, amounting to about 1 acre, is occupied by the new sidings, roadway, and traffic office (Fig. 2).

The quay is capable of eventual extension southwards, its alignment having also been chosen so as not to interfere with the working of the Iron Ore quay, which it was necessary to keep in operation throughout the period of construction in order to maintain the trade of the dock. The cranes and railways on this old quay have since been removed and it is now used only as a waiting berth.

The new quay has seven lines of railway, three on the quay proper and four on the reclaimed land behind and is equipped with six 3-ton and two $5/2\frac{1}{2}$-ton level luffing electric travelling portal cranes and eleven electric capstans for shunting purposes (Fig. 3). The 3-ton cranes have a clear outreach beyond the floating fenders of 66-ft. and can plumb all seven railway lines. The $5/2\frac{1}{2}$-ton cranes have a clear outreach of 48-ft. and can plumb six of the lines. A 10/5-ton crane of similar type, with a clear outreach of 43-ft., was added in 1943.

The railways on the quay have a minimum radius of 6 chains and the minimum radius for all permanent lines off the quay is $5\frac{1}{2}$ chains. Dock traffic and traffic for exchange with the London and North Eastern Railway Company's group of sidings to the south of of warehouses Nos. 7 and 8 is handled from both ends of the quay.

FIG. 2



NORTH-WEST QUAY SITE PLAN
DREDGING AND FILLING

The main point of engineering interest in the construction of this quay is the foundations. Test-piles driven in 1928 and borings taken in 1934, and again in 1937, showed that no firm foundation existed above about 80-ft. below High Water of Ordinary Spring Tides at the south end of the quay and about 100-ft. below this level at the north end and that only a muddy, sandy silt existed until the beds of gravel and sandstone or shale which lay beneath were reached. This state of affairs obtains over most of the area covered by the dock, except at the entrances and along the site of the Factory quay and again at the south end along the inner half of the coal staiths and the Warehouse quay, where clay beds occur at a reasonable depth. Experiments undertaken by Mr. Harrison to test the bearing capacity of the silt by loading an area of 10-ft. square indicated that it would support only 7-cwt. per superficial foot without settlement and that as soon as that weight was exceeded the whole began to sink.

Soundings taken at the site of the quay showed that the steepest slope at which this material stood was about 3 to 1, and that the average slope was about 5 to 1. In these circumstances it was decided to design an open type of quay of sufficient width for lateral stability against blows from ships berthing alongside and against wind-pressure from the cranes, and to employ a steel piled bulkhead along the back of it, with independent anchorages, to retain the reclaimed ground

The quay was to be of reinforced concrete supported upon two rows of cylindrical piers founded upon piles driven down to the gravel and sandstone or shale beds.

Trial Cylinder.—In order to test the feasibility of this proposal, a trial cylinder was sunk from one of the old pit-prop jetties, in such a position and of such dimensions that if satisfactory it could be utilised as part of the permanent work. In the early part of 1938 a steel cylinder of 8-ft. internal diameter, with shell plating $\frac{1}{2}$-in. thick, so that compressed air could be employed if obstructions were encountered, and an overall length of 54-ft. was accordingly pitched on the line of the proposed front row, and was sunk through about 43-ft. of silt by grabbing to a depth of

Two New Quays at Tyne Dock, South Shields—*continued*

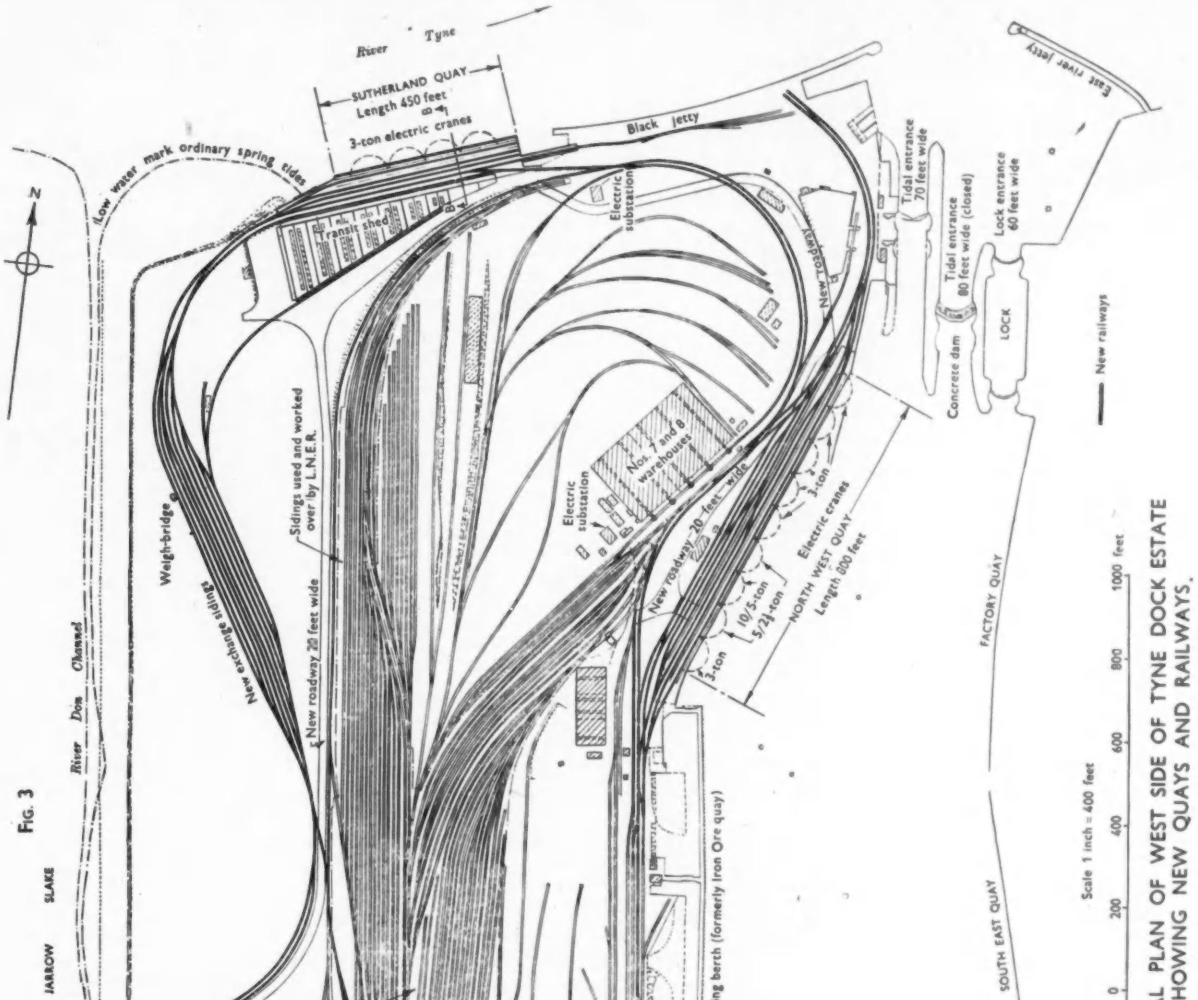


FIG. 3

GENERAL PLAN OF WEST SIDE OF TYNE DOCK ESTATE SHOWING NEW QUAYS AND RAILWAYS.

Two New Quays at Tyne Dock, South Shields—*continued*

48-ft. 6-in. below High Water of Ordinary Spring Tides, that is 13-ft. 6-in. below the proposed dredged level of the berth. About 60 tons of kentledge was required to complete the sinking, and when the cutting-edge reached its final level about 8-ft. of material was still left inside the cylinder.

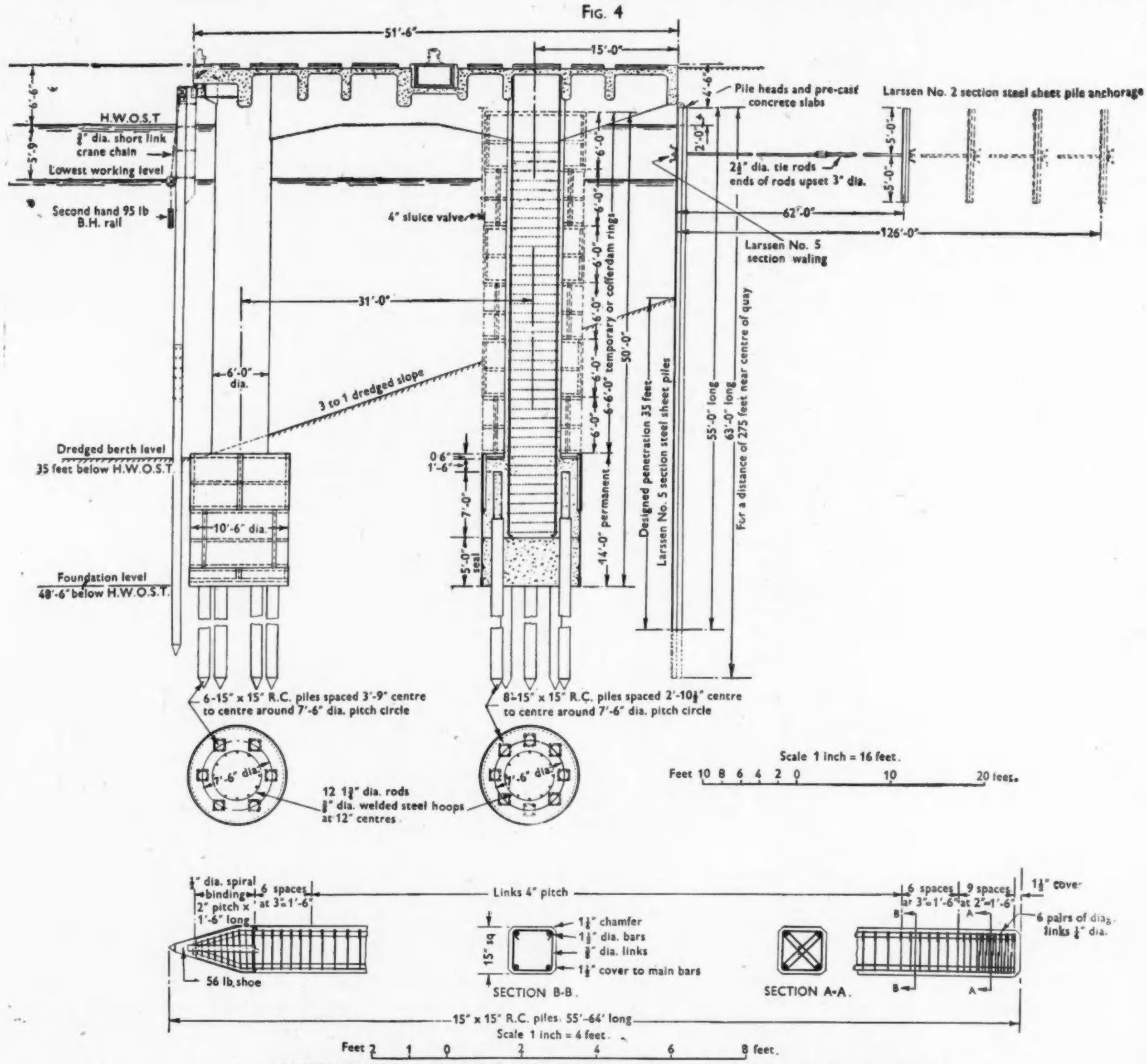
Excavation was completed by hand to within 1-ft. 6-in. of the cutting-edge, and guides were inserted for driving six 14-in. by 14-in. section Oregon pine piles 64-ft. long, spaced 2-ft. 6-in. apart centre to centre round a 5-ft. diameter pitch circle. The piles were driven without difficulty to a firm bearing at about 96-ft. below High Water of Ordinary Spring Tides by means of a $2\frac{1}{2}$-ton single-acting hammer and a timber dolly 34-ft. long. After driving, the heads of the piles, which had been held solely by the dolly pin for the last 5-ft., were found to have a slight inclination towards the centre of the cylinder; they were, however, easily jacked apart and made plumb. The cylinder remained dry the whole time, but the bottom rose about 9-ft. 6-in. while the piles were being driven. On re-excavation the bottom again began to rise, the over-night movement amounting to as much as 1-ft. 6-in., and on account of this tendency it was not found possible to excavate any lower than about 3-ft. above the cutting-edge.

The walls of the cylinder were therefore cleaned down and the reinforcement for the concrete column surmounting the piles was inserted. A seal of rich concrete was then deposited in the dry around the heads of the piles and the cylinder was later filled with concrete to deck-level. When loaded subsequently with the equivalent of 56 tons per pile, the total settlement over a period of 3 days amounted to 5/32-in., with recovery to 1/32-in. after removal of the load. The skin friction, calculated on three occasions while sinking was in progress, was found to be between $1\frac{1}{4}$ and $1\frac{1}{2}$-cwt. per sq. ft.

As a result of the experience gained in sinking this cylinder it was possible not only to evolve with some confidence a simple form of design but also to place data before tenderers which would be of value to them for estimating purposes.

Test-Piles.—Uncertainty still remained as to the depth to which the piles would require to be driven along the rest of the quay to reach a similar bearing and, in order to determine this as nearly as possible, the driving resistance of the ground from surface to shale-level was explored at eight equidistant points along the quay by driving, from craft, test-piles consisting of a $4\frac{1}{2}$-in. diameter tube within an 8-in. diameter guide tube. This method, which enables

FIG. 4



NORTH-WEST QUAY-QUAY SUBSTRUCTURE AND STEEL-PILED BULKHEAD.

Two New Quays at Tyne Dock, South Shields—continued

the cumulative driving resistance of the various strata to be recorded graphically, in pounds per square inch of projected pile-shoe area, for comparison with the resistance of three empirical classes of ground, namely, soft, firm, and hard, has been described elsewhere[1]. In this case, knowing the depth to which the piles in the trial cylinder had been driven, the lengths of the piles could be estimated from the graphs by interpolation.

Substructure and Foundations.—The two rows of cylindrical piers upon which the quay is carried are 30-ft. apart longitudinally and 31-ft. apart transversely. Each pair of piers is framed together with a portal beam 5-ft. 6-in. deep by 2-ft. 6-in. wide, which supports the crane beams and rail beams and braces the structure laterally (Fig. 4). The deck, with its crane track and three lines of railway, is 51-ft. 6-in. wide and overhangs the centre-line of the back row of cylinders by 15-ft., so as to allow a good clearance between the piers and the steel piled bulkhead, which runs just beneath the beam at its rear edge. The over-hanging portion of the deck is supported upon cantilevered extensions of the portal beams, the soffits of which are well clear of the top of the bulkhead, so that no pressure can come against the concrete quay.

The piers are carried upon 15-in. by 15-in. section precast 1 : 1½ : 3 concrete piles reinforced with four 1½-in. diameter round bars and ⅜-in. links 4-in. apart centre to centre. There are eight piles per pier in the back row and six per pier in the front row, with lengths ranging from 55-ft. to 64-ft.

The quay foundations are designed for full crane and railway loading (20-ton wagons and six-coupled dock shunting locomotives) or a live load of 3-cwt. per sq. ft. The portal beams, etc., and the decking, however, are designed for a live load of 600 lbs. per sq. ft. up to within 5-ft. 6-in. of the cope, in order to provide for any local concentration of loads. The maximum reaction per pile in the former, or normal, case is 50 tons, and in the latter, or extreme, case, 65 tons.

In order to accommodate eight 15-in. by 15-in. piles and secure a reasonable spacing between them, a steel cylinder with an internal diameter of 10-ft. 6-in. was necessary. This was 2-ft. 6-in. more than in the case of the trial cylinder, but had the advantage of improving the degree of fixity of the substructure and rendering it better able, in the soft ground, to withstand lateral loading due to blows from ships, etc. On the other hand, in view of the tendency noted in the case of the trial cylinder for the bottom to rise, sinking and pile-driving were carried out through water instead of in the dry, in order to preclude the possibility of a "blow."

Above the level of the dredged berth the 10-ft. 6-in. diameter, or base, portion of the pier, gives way to a 6-ft. diameter reinforced column which continues to deck-level.

The piers were constructed inside steel cylinders 10-ft. 6-in. internal diameter, 50-ft. long, made up of a cutting-edge ring 2-ft. long, 2 permanent rings, and 6 temporary rings, each 6-ft. long. The shell plating was 5/16-in. thick and the rings were of sufficient strength to withstand an air-pressure of 20 lb. per sq. in., the joints being caulked to resist both external water-pressure and internal air-pressure.

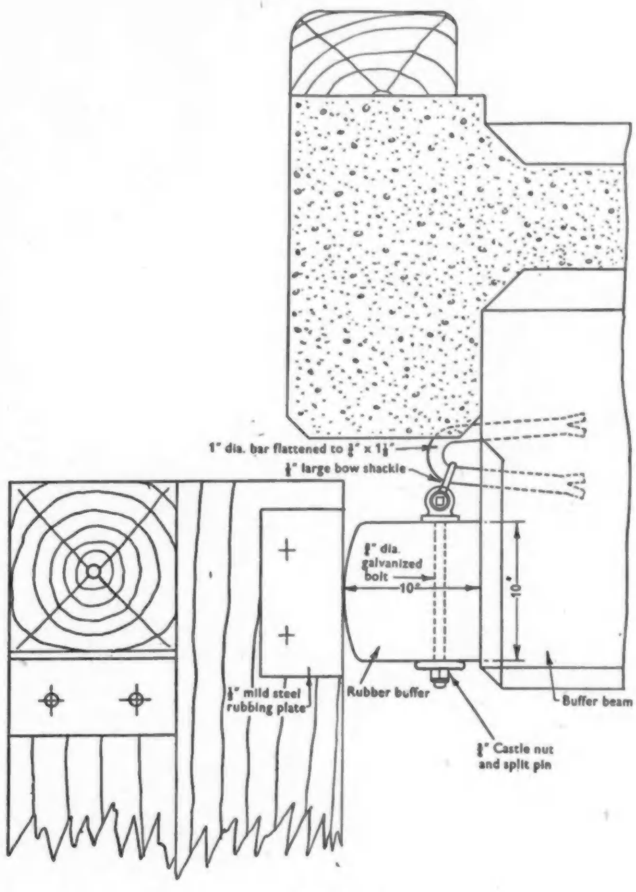
The cylinders were first of all sunk by open grabbing and weighting to about 48-ft. 6-in. below High Water Ordinary Spring Tides. A guide-frame was then introduced and the piles were inserted at equal intervals round a 7-ft. 6-in. diameter pitch circle (2-ft. 10½-in. centre to centre in the case of the back row and 3-ft. 9-in. centre to centre in the front row), their lengths being such that the level of the heads after driving would be not less than 12-ft. above the cutting-edge.

After driving had been completed and the displaced material removed, the cylinder was sealed with 5-ft. of 1 : 1 : 2 concrete deposited through the water. After about three days the water was pumped out and the protruding portions of the piles were stripped to expose the main bars. Next, the reinforcement of the 6-ft. diameter column was inserted, giving a total lap of 7-ft., and the concrete was brought up a further 8-ft. 6-in. to within 6-in. of the top of the permanent rings.

The shuttering for the 6-ft. diameter column was then erected and the pier was constructed to portal beam level with 1 : 2 : 4 concrete. Finally, after the shuttering had been removed, the temporary or cofferdam portion of the steel cylinder was unbolted from the permanent portion, filled with water through a 4-in. sluice valve fitted in one of the rings, and jacked out of the ground for re-use.

The quay is carried upon sixty-three of these columns, and in no case was it found necessary to use compressed air.

FIG. 5



Scale 1 inch = 1 foot.

Inches 6 4 2 0 1 2 feet.

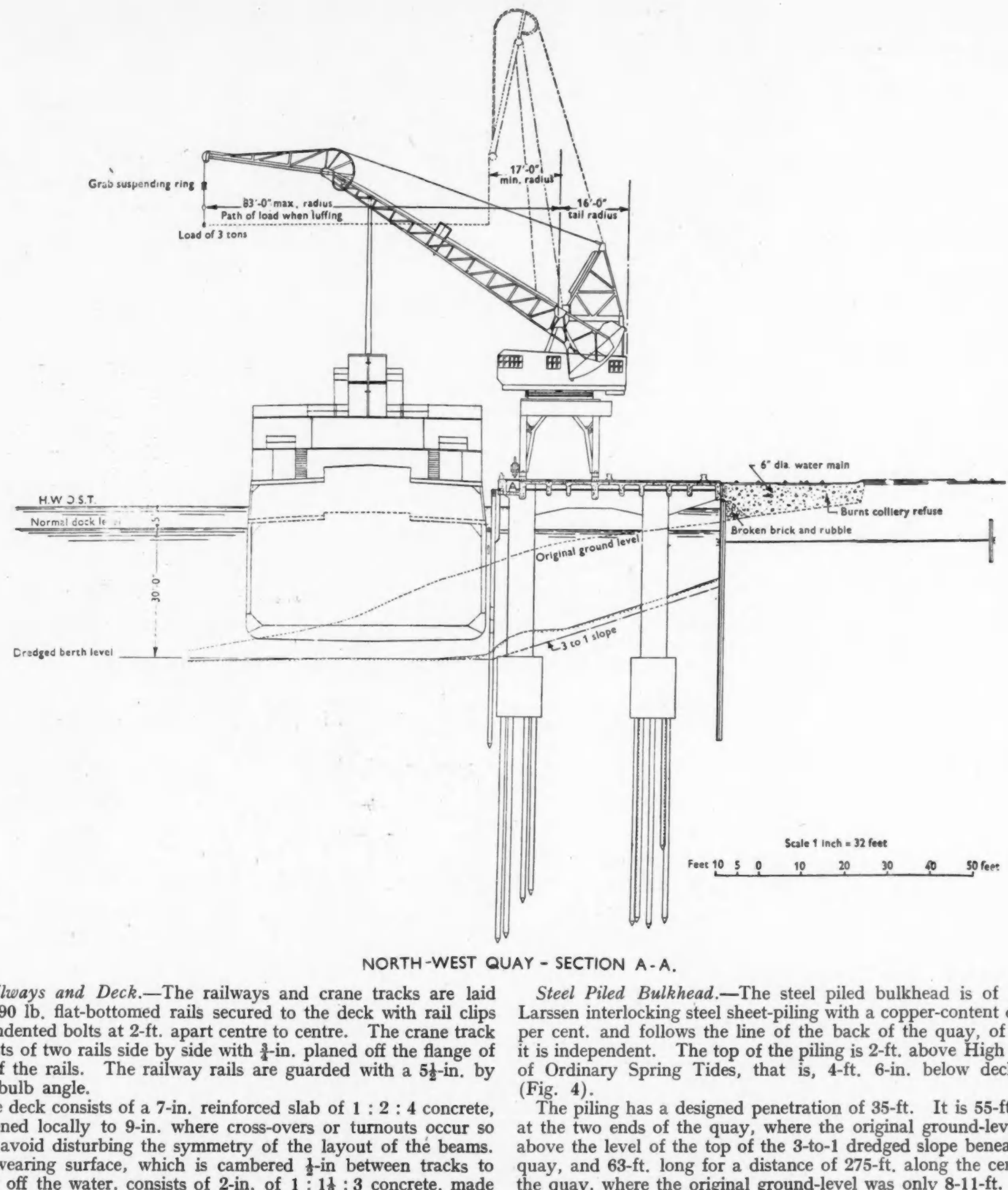
NORTH-WEST QUAY-FENDERING.

Fendering.—Flexible fendering was essential to enable the structure to withstand blows from ships without sustaining damage, and two rubber buffers per 30-ft. bay are provided immediately beneath the cope beam, each capable of sustaining a lateral load of 14 tons with slightly less than 3-in. compression (Figs. 4 and 5). The rubber buffers are wedge-shaped, 10-in. high, 12-in. wide, and 10-in. thick, and bear against a buffer-beam cast integrally with the front crane beam and the deck. They work in conjunction with a continuous horizontal timber fender, running at the same level, supported upon single timber piles built up to double thickness above water-level. The front of the buffer, which has a rounded face, is kept in contact with the back of the built-up pile by means of a couple of short chains stretched diagonally in either direction between the buffer-beam and the horizontal fender. A single floating fender is provided per 30-ft. bay. All the timber in the fenders is creosoted Oregon pine of 12-in. by 12-in. section.

[1]A. Hiley, Assoc.M.Inst.C.E., "Pile-Driving Calculations, with notes on Driving Forces and Ground Resistance," "The Structural Engineer," vol. 8, July and August, 1930. M. J. C. McCarthy, Assoc.M.Inst.C.E., "Soil Mechanics and Concrete Pile-Driving," Paper read before Institution of Structural Engineers, January, 1937.

Two New Quays at Tyne Dock, South Shields—continued

FIG. 6



NORTH-WEST QUAY - SECTION A-A.

Railways and Deck.—The railways and crane tracks are laid with 90 lb. flat-bottomed rails secured to the deck with rail clips and indented bolts at 2-ft. apart centre to centre. The crane track consists of two rails side by side with $\frac{3}{8}$-in. planed off the flange of one of the rails. The railway rails are guarded with a $5\frac{1}{2}$-in. by 3-in. bulb angle.

The deck consists of a 7-in. reinforced slab of 1 : 2 : 4 concrete, thickened locally to 9-in. where cross-overs or turnouts occur so as to avoid disturbing the symmetry of the layout of the beams. The wearing surface, which is cambered $\frac{1}{2}$-in between tracks to throw off the water, consists of 2-in. of 1 : $1\frac{1}{2}$: 3 concrete, made with whinstone aggregate, upon a base of $3\frac{1}{2}$-in. of 1 : 2 : 4 concrete. Drain-holes, $2\frac{1}{2}$-in. diameter, are provided 15-ft. apart centre to centre alongside each of the rail grooves.

There are no expansion joints in the deck, but a row of whinstone setts, bedded on sand and jointed with bitumen, is provided on both sides of each rail.

The concrete, generally, is ordinary grade concrete in accordance with the Code of Practice issued by the Department of Scientific and Industrial Research in 1934.

Steel Piled Bulkhead.—The steel piled bulkhead is of No. 5 Larssen interlocking steel sheet-piling with a copper-content of 0.35 per cent. and follows the line of the back of the quay, of which it is independent. The top of the piling is 2-ft. above High Water of Ordinary Spring Tides, that is, 4-ft. 6-in. below deck-level (Fig. 4).

The piling has a designed penetration of 35-ft. It is 55-ft. long at the two ends of the quay, where the original ground-level was above the level of the top of the 3-to-1 dredged slope beneath the quay, and 63-ft. long for a distance of 275-ft. along the centre of the quay, where the original ground-level was only 8-11-ft. above dredged berth-level.

The anchorage consists of interlocking steel sheet-piling, 10-ft. long, of No. 2 Larssen section, driven into undisturbed ground along the dock bank at distances ranging from 62-ft. to 126-ft. behind the bulkhead. The tie-rods are 5-ft. $6\frac{1}{4}$-in. apart centre to centre and consist of $2\frac{1}{2}$-in. diameter mild steel rods with upset ends joined together with forged union screws. The waling is a No. 5 Larssen pile fixed at 3-ft. below High Water of Ordinary Spring Tides. The filling is burnt colliery refuse having a con-

Two New Quays at Tyne Dock, South Shields—*continued*

solidated weight of 94 lbs. per cubic ft., and the bulkhead is backed with a bank of old bricks and rubble (Fig. 6).

The sheet-piling, tie-rods and waling were coated with bitumastic solution and hot enamel, and in addition the tie-rods, after fixing, were wrapped with hessian and given two coats of hot tar.

Construction

Work upon the quay was begun in February, 1939, the contract time being 86 weeks.

Steel Piled Bulkhead.—The construction of the steel piled bulkhead was undertaken first, the main sheet-piling being mostly driven from floating craft using a guide waling bolted to a line of temporary timber piles. The tie-rods were stressed to the limit of the bearing capacity of the anchorages by tightening the union screws. The pull per rod required to do this was found by extensometer test to be about 20 tons.

The filling was deposited by lorries and was spread in layers by a caterpillar crane fitted with a grab, the brick rubble backing to the piling being tipped independently, ahead of the filling, from a crane.

Dredging. The requisite dredging of the berth and the formation of a 3-to-1 slope in front of the sheet-piling at the two ends of the quay were carried out by one of the Commissioners' bucket ladder dredgers (Fig. 2).

Cylinder-sinking and Pile-driving.—The sinking of the cylinders was carried out by means of 10-ton steam derricks travelling on timber baulks just behind the sheet-piling. In order to bring the tops of the cylinders above dock water-level it was necessary to pitch a 38-ft. length in one operation, that is, four temporary sections in addition to the two permanent sections and cutting-edge, and this was done by a floating sheerlegs, the weight involved being about 16 tons. The remaining two sections were added as sinking proceeded. The quantity of kentledge required varied between 20 tons and 45 tons in the case of the front cylinders and between 34 tons and 73 tons in the case of the back cylinders. Four timber piles, driven 20-ft. below dredged berth-level and braced at the top, were required for each cylinder to act as guides during sinking and to serve as staging for the pile frame.

The concrete piles in the cylinders were driven with a 4-ton single-acting steam-hammer having a 4-ft. drop. The dolly, or follower, was of greenheart, 48-ft. 9-in. long overall, whilst the device for guiding the pile and dolly consisted of two grids, one 35-ft. above the other, at the opposite ends of a timber frame suspended inside the cylinder. The pile helmet fitted the pile closely and was packed with old hemp rope. It was made as thin as possible, with welded steel plates, in order to pass easily through the top grid.

North-West Quay. June, 1940.
Looking North; quay deck under construction. Completed cylinders in foreground.

The specified set was 10 blows to the inch, at which the calculated driving resistance of the pile, according to the Hiley formula, was 1,100 lbs. per sq. in., or 110 tons. The estimation from the test-piles of the length of pile required was quite satisfactory, but it was found that where the shale was overlain by sand and gravel to any thickness the last three piles or so in both front and back cylinders did not drive so far as the others. The piles had an unexplained tendency to drift inwards during driving, that is, towards the centre-line of the cylinder which had to be counteracted by setting them to point slightly outwards before starting to drive. The proportion of broken heads was 2½ per cent.

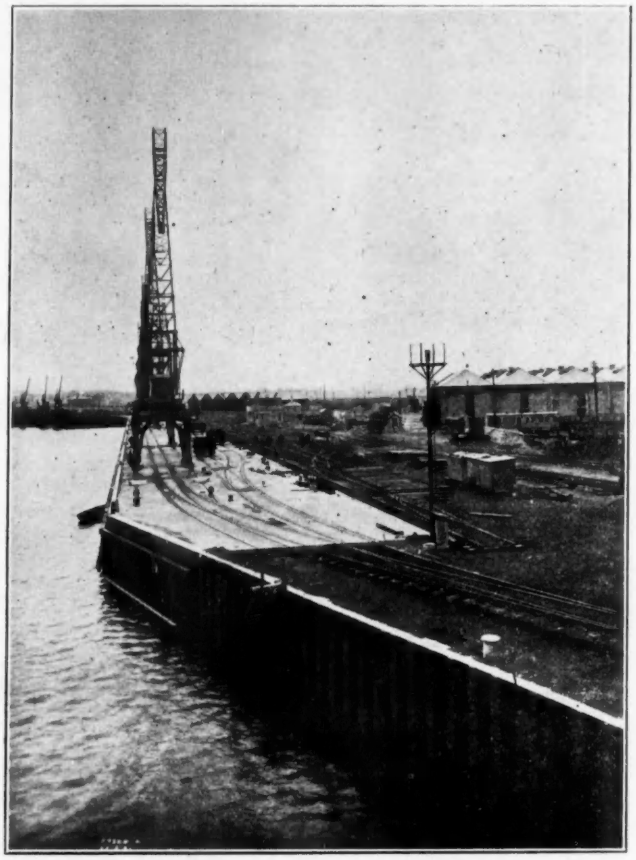
Upon completion of pile-driving the interior of the cylinder was cleaned by diver with the aid of a water jet and the surplus material was removed by grab. The cylinder was sealed by means of an under-water skip. After completion of the 6-ft. diameter column the temporary or cofferdam sections of the cylinder were extracted from the ground by means of two 35-ton hydraulic jacks.

North-West Quay. June. 1940. View beneath deck showing completed work.

Deck.—The details of the reinforced concrete in the portal

Two New Quays at Tyne Dock, South Shields—continued

beams, crane and railway beams and deck were prepared by Messrs. L. G. Mouchel and Partners, Limited. The portal beams were constructed in situ between a pair of temporary steel trusses, one on either side of each column, supported by timber posts resting on the base portion of the pier. The crane beams and rail beams were all pre-cast, their ends being supported temporarily on the steel trusses, whilst the deck shuttering was carried on timber runners secured to the beams. On account of the limited headroom the trusses had to be floated out from beneath the portal



North-West Quay. August, 1941.
Completed quay and sidings under construction, looking South. Floodlight standard in foreground.

beams on a raft. The front end of the truss was held by the derrick whilst the other end was lifted sideways and lowered by a travelling hand winch operating through a hole left temporarily in the deck.

Progress.—Cylinder sinking was started at the middle of the quay, working both ways, in order to have the central portion finished in time for the eight electric portal cranes which, owing to site restrictions, had to be erected on the middle of the reclaimed ground immediately behind the new sidings and hauled into position on the quay on skids.

Originally it had been proposed to work day and night on the sinking of the cylinders in order to keep up with the construction of the deck but, owing to the intervention of the war, six months after the commencement of the contract, it was decided to complete the northern portion of the quay first and then proceed with the southern half. The northern half was taken into use in January, 1941, and the southern half in June, 1941, 14 weeks and 37 weeks, respectively, beyond the contract time of 86 weeks.

Forward Movement of Sheet-piling.—As construction proceeded, a forward movement of the sheet-piling occurred over a distance of about 450-ft. along the central portion of the quay (Fig. 2). The alignment and level of the top of the piling remained practically unaltered, but the piling itself was found to have taken up an inclination from the vertical ranging from ¼-in. to 1-in. per foot, the rake being most pronounced where the original ground-level was lowest.

No further movement has since been observed, but as a precautionary measure the low ground in front of the piling at the centre of the quay was brought up to a 3-to-1 slope by depositing 3,800 tons of selected material consisting of chalk and gravel from a neighbouring ballast hill.

Whereas at the two ends of the quay the increased weight imposed by the filling on the ground immediately behind the bulkhead, taking the submerged weight of the material to be about 35 lbs. per cubic ft., did not exceed about 6½-8-cwt. per sq. ft., in the zone of movement the increased weight was of the order of 8-13-cwt. per sq. ft., that is, from about 15 per cent. to 85 per cent. in excess of the bearing capacity of the silt as adduced by Mr. Harrison from his test.

Analysis by the Swedish method[2] showed that the bulkhead apparently possessed an ample factor of safety against failure along a cylindrical slip-surface passing through the toe of the piling, and it seems to the Author that the piling was squeezed outwards by the lateral pressure of the over-loaded silt, the movement being gradually arrested as the internal friction, which would not become fully effective until a certain degree of deformation had taken place, began to develop.

(To be continued.)

Publications Received

For the first time for several years the **Monthly Circular** of the **Baltic and International Maritime Conference** has been published, the last issue being printed in February, 1941, and sent to a few members within reach. The July, 1945, number contains a short report of some of the matters dealt with during the intercalary period.

Factories Act, 1937.—A Summary for Iron and Steel Works is a convenient and timely publication by the United Steel Companies, Ltd., who point out that much of the Act is not applicable to Iron and Steel Works, and that there is evidence of need for a concise summary of the appropriate provisions.

Civil Engineering and Building Contracts is the title of a brochure issued by The Mitchell Construction Company of Bedford Square, London, W.C.1. It describes representative samples of the firm's contracts carried out during the quarter-of-a-century. They are largely Power Stations with some miscellaneous structure in cooling towers, locomotive coaling plants, etc. Copies of the brochure will be sent free upon application to the Company.

Railway Dry Docks, 1945, is the title of an illustrated brochure issued by the American firm of Crandall Dry Dock Engineers, Inc., of Cambridge, Mass., U.S.A. It is a description and historical account of the Crandall Railway Dry Dock, which perhaps would be better understood in this country if described as a slipway, consisting, as it does, of a Cradle travelling on an inclined track. The dock is closely associated with the growth of the firm, dating from about 1840, when William Hazard Crandall operated a shipyard at Newport, Rhode Island, and constructed two "marine railways," which proved so satisfactory that a number of others were ordered. The firm have now a long record of constructional work of the type in question, with, of course, numerous improvements incorporated from time to time. The brochure describes and illustrates these developments. It also includes in its 20 pages a short article on Vessel Tonnage and Weight, which, with information about blocking heights, is a useful explanation of dry dock technique.

[2]Charles Terzaghi, "The Mechanics of Shear Failures on Clay Slopes and the Creep of Retaining Walls," "Public Roads," vol. 10 (1929-30), p. 177. L. F. Cooling, and D. B. Smith, "Shearing Resistance of Soils," (Note to the Institution Sub-Committee on Earth Pressures), J.Instn.Civ.Engrs., Vol. 3 (1935-36), p. 333 (June, 1936).

Impact Stresses in Jetties, Wharves and Similar Structures

A Critical Analysis

By P. GARDE-HANSEN, B.Sc.,
Assistant Manager, Christiani and Nielsen, Ltd.

Introduction.

It will be attempted in the following to analyse the effect on a jetty, wharf or similar structure of the impact caused by a vessel being berthed alongside the structure. During the operation of berthing a vessel it comes into contact with the structure several times before it is finally moored alongside. When the vessel is moored, it also comes into contact with the structure at frequent intervals as the wind and current moves it away from and up against the structure. At each contact an impact occurs, and this analysis is concerned with determining the magnitude of the impact, the resulting impact-force and the stresses caused by this. No comprehensive analysis has been made of this nature to the writer's knowledge, and no text-book gives any directive for the calaculation of stresses in marine structures caused by impact forces. Most designs are therefore based on "established practice," which often means designs containing quite unnecessary elaborate bracing having to be carried out tidally.

It is admitted that the knowledge of what actually happens during an impact of the nature in case is limited, and a very high degree of accuracy is therefore not claimed for the method of calculation derived in the following, but it is claimed that it leads to results that are safe; but not uneconomically so.

It appears justified to assume that the first impact when a vessel is being berthed is the heaviest, and that the intervals between succeeding impacts are of sufficient duration to permit the effects of one to pass before the next occurs.

The impact is rarely delivered directly to the structure proper as this is normally provided with a fenderwork. This fenderwork is of great importance and must be designed to be of sufficient strength to resist the impacts from vessels berthing under normal conditions.

In the following it will generally be assumed that the jetty, wharf or similar structure is a piled reinforced concrete structure. There is, however, nothing in the analysis which does not apply equally well to structures of other materials.

The following two cases are to be considered both in regard to the fenderwork and to the structure proper:

(*a*) Berthing of vessels under normal conditions, i.e., under the worst combination of wind and tides under which a vessel in the general course of events will be brought alongside the structure.

(*b*) Accidental collision on berthing under exceptional conditions, i.e., under such conditions that damage to the structure, to the vessel or to both is to be expected.

It is the writer's opinion, that it is not justified to design a jetty or other structure to be able to resist the impact from a head-on collision or other exceptional and abnormal occurrence without damage to the structure or at least to the fenderwork, as this would mean a very costly structure and probably lead to the vessel suffering very extensive damage with a resulting much greater total monetary loss than if the structure had been of a lighter construction and suffered some damage. In accordance with the preceding it is contended that in calculating the impact stresses it is sufficient:—

(*a*) to consider the impact at the first contact only.

(*b*) to consider impacts of the magnitude caused by berthing under normal conditions only.

(*c*) to allow an appropriate margin of safety when designing for normal conditions.

Having made these limitations to the scope of the analysis the problems of this present themselves in the following order:—

1. Determination of the magnitude and direction of the impact.
2. Determination of the proportion of the vessel's kinetic energy transferred to the structure.
3. Design of the fenderwork and, possibly, determination of the amount of kinetic energy absorbed by it.
4. Determination of the stresses in the structure proper.

Nature of Impact.

It will be practical to recapitulate what occurs during and immediately after an impact between a moving body and a body at rest, before the analysis proper is proceeded with.

The impact may be elastic or in-elastic.

In the case of an in-elastic impact permanent deformation of the bodies results. These deformations continue to increase as long as the bodies act on each other, i.e., until they have attained the same velocity. As the deformations remain and accordingly do not counteract the two bodies will continue with the same velocity. The permanent deformations have absorbed part of the kinetic energy of the moving body, or the whole if the movement is arrested.

In the case of an impact between two elastic bodies, elastic deformations occur as long as the bodies act on each other, and they will move with the same velocity until the kinetic energy of the moving body has been spent in internal deformation work. When this stage has been reached the elastic deformations will commence to decrease and finally disappear so that no kinetic energy is lost. When the internal deformations have disappeared the two bodies will move with different velocities according to the following equations:—

$$\tfrac{1}{2}MV^2=\tfrac{1}{2}MU^2+\tfrac{1}{2}mU_1{}^2$$

and:— $$MV=MU+mU_1$$

which solved give:—

$$U=\frac{M-m}{M+m}V$$

The laws of impact contained in the equations above apply to impacts where the direction of movement lies on the line connecting the centres of gravity of the two bodies and where the tangent planes at the points of contact are perpendicular to this line. If this is not the case the impact will also cause rotation of the bodies whereby kinetic energy is absorbed. The nature of the impact, being the subject of this analysis, varies considerably from the ideal cases described above. The direction of movement will rarely lie on the line connecting the centres of gravity of the bodies, and these will neither be completely elastic nor completely in-elastic, further, the body at rest is not free to move.

The nature or type of the impact under consideration may be described as an impact between a moving body and a beam on elastic supports. The quantity of kinetic energy necessary to cause a certain elastic deformation is absorbed by the normal stresses and the shear stresses; it is, however, known that the latter may be ignored, and the energy absorbed by the former is expressed by:—

$$A_i=\frac{1}{2E}\int\frac{Mx^2}{Ix}\,dx \quad (1)$$

where E=coefficient of elasticity, M=bending moment and I=moment of inertia.

The energy absorbed by the deformation of the elastic supports is expressed by the equation $A_s=\tfrac{1}{2}\Sigma RY$ (2) where R=reaction and Y=deflection of support.

The total energy absorbed is thus:—

$$A=A_i+A_s \quad (3)$$

Impact Stresses in Jetties, Wharves and Similar Structures—continued

When P is the force with which the two bodies act on each other (the body causing the impact and the beam) and Y_p is the deflection of the beam at the point of impact, then :—

$$\tfrac{1}{2}PY_p=A \quad (4)$$

The development of equations (2) and (4) assumes that P commences at Zero and increases gradually, although in a very short time to P.

In the deformation work of the beam exists an expression for the beam's capacity to resist impacts. This can now be used for the calculation of the stresses in the beam and the reactions on the supports as the value of P can be calculated as follows. Let

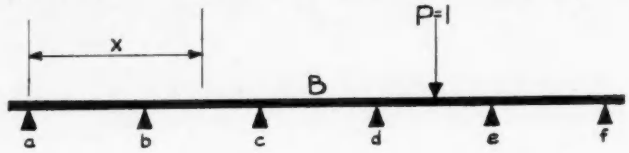


Fig. 1.

P=unit of force in Fig. 1, it is then possible to calculate the resulting moments M_x at the various points of the beam, the reactions R'_a, R'_b, etc., and the deflection Y'_p at the point of impact; and as the deflection of the point of impact is PY'_p for the force P equation (4) gives :—

$$\tfrac{1}{2}P(PY'_p)=A \text{ or } P=\frac{\sqrt{2A}}{\sqrt{Y'_p}} \quad (5)$$

where A is the kinetic energy transferred to the beam.

When P has been determined the calculation of bending moments, reactions and stresses are calculated in the usual manner.

It is to be remembered that a force applied suddenly with its full value causes dynamic stresses twice as great as the static stresses caused by a force of the same final value, but applied gradually.

It has so far been assumed that the beam has no mass, i.e., no weight. The calculations will become much more complicated if this assumption is not made, and as the error is on the side of safety the same assumption will be made in this analysis.

The calculations of bending moments, reactions and deflections for continuous beams on elastic supports have been made by Clapeyron, Claxton-Fidler, Ostenfeld and others; and for use later

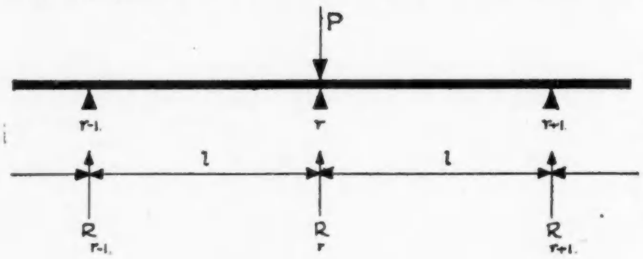


Fig. 2.

in this analysis the following formulæ, corresponding to the beam shown in Fig. 2, are quoted from Ostenfeld :—

$$R_r=\frac{a+\frac{1}{3}}{a\,b}\,P \quad (6) \qquad M_r=-\tfrac{2}{3}\frac{e}{ab}\,Pl \quad (7)$$

$$M_r-1=M_r+1=-\frac{1-a+b}{1+a+b}\,M_r \quad (8) \text{ where :—}$$

$$e=\frac{6EIK}{l^3} \qquad a=\frac{\sqrt{1+8e}}{\sqrt{3}} \qquad b=\frac{\sqrt{4+2a}}{\sqrt{3}} \quad (9)$$

and :—K=deflection of a support per unit of force.
E=coefficient of elasticity for the beam.
I=moment of inertia of the beam.

If P acts over the first support then :—

$$R_1=\frac{2b}{1+a+b}\,P \quad (10)$$

It is obvious that the greatest reaction must occur over the support at which the force P is applied. Equations (6) and (10) suffice accordingly for the determination of the stresses in the supports.

The greatest bending moments are determined by equations (7) and (8) and by the following equations :—

(*a*) for P acting at the centre of an intermediate span :—

$$\text{at centre} \qquad M=\frac{1+2a}{8b}\,Pl \quad (10a)$$

$$\text{over supports} \quad M_r=\frac{2b-2a-1}{8b}\,Pl \quad (11)$$

(*b*) for P acting at the centre of the end spans :—

$$\text{at centre} \qquad M=1+\frac{2a+2ab}{2(1+a+b)^2}\,Pl \quad (12)$$

When equation (6) is written as :—

$$R_r=\left(\frac{1}{b}+\frac{1}{3ab}\right)\;P$$

it is apparent from equations (9) that the greater K and I are the smaller is R_r, i.e., the distributing effect increases with the flexibility of the supports and the stiffness of the beam. If on the other hand K or E or both=O we find R_r=P.

The distributing effect of the beam may be so great that the impact force is distributed equally over all supports.

Equation (5) shows that the greater Y_p is, i.e., the greater the deflections of the supports are the smaller is the impact force P.

The preceding can be summarised as follows :—

The effect of a given impact on a continuous beam on elastic supports is in inverse proportion to the stiffness of the beam and the elasticity of the supports.

The Y'_p in equation (5) is the elastic deflection of the system at the point of impact. This deflection is composed of :—

(*a*) the elastic deformation of the beam.
(*b*) the elastic deflection of the supports.

In the case where the impact occurs over a support (*a*) may be ignored.

Magnitude of Impact.

The magnitude of an impact of the nature being the subject of this analysis depends upon

(*a*) The size of the vessel causing the impact.
(*b*) The speed of the vessel before and after the impact.
(*c*) The angles between the directions in which the vessel is moving before and after the impact, and the front of the structure.

The size of the vessel in this connection is its displacement tonnage measured by weight. It is to be remembered that neither the register tonnage nor the deadweight tonnage of a vessel is in any common relation to the displacement tonnage. The displacement tonnage can be calculated with sufficient accuracy by the formula :—

$$W=K\,\frac{LBD}{35}\text{ ton} \quad (13)$$

where : L=length in waterline in ft.
B=breadth in waterline in ft.
D=average draft in ft.
K=block coefficient.

The value of K is approximately for :—

small slow cargo vessels	..	0.80—0.85
small faster cargo vessels	..	0.75—0.80
large cargo vessels	..	0.70—0.75
large fast cargo vessels	..	0.65—0.70
large fast passenger vessels	..	0.60—0.65

It must be considered sufficient to design the structure for the impacts from vessels of the size for which it is to be built.

A vessel about to berth will not approach the structure at full speed; but at the lowest possible speed at which it can maintain steering way. The speed required for this purpose depends very much on the vessel itself and also on wind, tide and currents. It is accordingly not possible to give a general ruling for the speed to be taken into account, and this must be decided in each individual case. Such a decision should not be made by the designing engineer without thorough examination of local conditions and consultation with representatives of the maritime interests in the structure.

Impact Stresses in Jetties, Wharves and Similar Structures—continued

The direction under which a vessel approaches a jetty, a wharf or a similar structure, forms normally quite a small angle with the front of the structure. It may be safely assumed that this angle does not exceed 20°. The manner of approach is shown on Fig. 3. The vessel will impart the first impact to the structure at A, the impact will reduce the speed of the vessel and cause it to sheer off and proceed with reduced speed in a direction forming a smaller angle with the front of the structure than that with which the vessel approached it. Succeeding impacts, checks and finally stops the vessel assisted by two or more mooring ropes run ashore.

It is obvious that the most favourable conditions for berthing obtain, when wind and current have the same direction and are parallel with or slightly off the structure and the vessel approaches against this direction, as in this case steering way can be kept with very little speed.

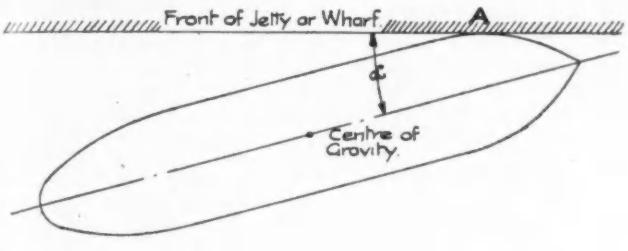


Fig. 3.

The most unfavourable—but perhaps still " normal conditions " obtain when the vessel approaches with wind and current behind as the speed must then be somewhat greater than that of the current to maintain steering way. The immediately preceding illustrates the influence of local conditions, and it is obvious that these must govern the locating of the jetty or other structure and that very careful consideration should be given to them so that the approach becomes as easy and as safe as possible. In his considerations in this respect the engineer should also seek the advice of the mariner.

Impacts between a vessel and a jetty, a wharf or a similar structure may also occur, as already mentioned in the introduction, when the vessel is moored alongside the structure. In this case it also depends upon local conditions with what speed the impact occurs, namely, upon current and wind causing it, but otherwise the problem is much simpler as the whole of the kinetic energy is lost in the impact and no alteration in the direction of movement occurs. It may be assumed, further, that the vessel will leave its berth if current, wind and waves are approaching conditions under which damage is likely to be caused to the structure, the vessel or both. It is, therefore, possible in this case to fix a value for the velocity of the impact, and the value of 1.5 ft. per second is often adopted.

Having decided the speed V of the vessel on which it is necessary to reckon the kinetic energy of the vessel is calculated by the formula :

$$K=\frac{1}{2}\frac{W}{g}V^2=\frac{1}{64.4}WV^2 \text{ ft. ton} \quad (14)$$

where V is measured in ft. per second.

Kinetic Energy transferred to the Structure.

The impact between the vessel and the structure causes the vessel to change course (direction of movement) and speed. The kinetic energy of the vessel after the impact is :

$$k=\frac{1}{64.4}Wv^2 \text{ ft. ton}$$

when v is the speed in ft. per second after the impact. The loss in kinetic energy is thus

$$E=\frac{1}{64.4}W(V^2-v^2) \text{ ft. ton} \quad (15)$$

and this loss is accounted for by :—

E_1=energy absorbed by deformation work of the vessel itself caused by compression and torsion.

E_2=energy absorbed in overcoming the frictional resistance of the water to the change in the direction of movement of the vessel.

E_3=energy transformed to heat by friction between the vessel and the structure while it is moving forwards in contact with this immediately after the impact.

E_4=energy absorbed by deformation work of the structure itself. It is the determination of $E_4=C_4\times E$ with which this analysis is concerned, and it must be admitted that the determination of C_4 is very greatly a matter of conjecture, and in the writer's opinion always will remain so. The only manner in which C_4 can be determined is by observation of deflection of structures under known conditions of impact, i.e., when w, V, v and direction of movement before and after impact are known. From the observed deflection E_4 can be calculated and thereafter C_4.

There can be no doubt, however, that E_1 depends upon the construction of the vessel, and E_2 and E_3 on the vessel's speed and direction of movement, so that even for a given structure C_4 is not constant.

A few observations and calculations made and also some experiments made by R. R. Minikin (see his paper in the *Structional Engineer*, August, 1943) appear to indicate that C_4 does not exceed 0.2, and for the purpose of the remainder of this analysis this value will be used.

The kinetic energy absorbed by deformation work in the structure is thus approximately :

$$A=E_4=0.003w(V^2-v^2) \text{ ft. ton} \quad (16)$$

and it is this value from which the impact force is to be calculated.

The immediately preceding may appear a weak basis for developing a method of calculation of impact stresses ; but the method will be developed in such a manner, that any research work carried out to improve the accuracy of the basic assumptions will not necessitate any amendments to the method of calculation. The writer, therefore, considers this analysis justified in the hope that authorities having the facilities for making such observations and calculations which may improve the accuracy of the basic assumptions will do so and publish their researches.

In the meantime the analysis may be used such as it is when suitable safety factors are used—or, perhaps, "ignorance factors" would be a better name.

In the case of impacts from a vessel already moored alongside the structure it may be assumed that the speed of the vessel after the impact is v=O. It is further obvious that no energy is absorbed by the vessel sheering off ; but some may be transformed into heat by friction if the vessel, e.g., rises on the crest of a wave at the time of the impact. The proportion of the vessel's kinetic energy transferred to the structure is thus undoubtedly greater in this case than in the case of an impact delivered by a vessel berthing. For this analysis it is assumed that the kinetic energy to be absorbed by the structure is determined by C_4=0.30, i.e., by :—

$$A=E_4=0.0045wV^2 \text{ ft. ton} \quad (17)$$

The observations made above regarding the value of C_4 also apply in this case.

In this case the impact is, however, not delivered at one point or over a short distance, but all along the structure. If the vessel is in contact with n fenders we may reckon that the energy transferred at each fender is $\frac{1}{n}\times A$.

Fenderwork.

The fenderwork serves the purpose of protecting the structure proper against surface damage from impacts from the vessels using the structure. Such damage, although superficial, would in time cause the structure to deteriorate, e.g., in the case of a reinforced concrete structure where some of the reinforcement has been bared this would rust and cause further spalling of the concrete. The fenderwork also protects the vessel against damage from the impact with the structure proper and lessens the effect on this of the impact by absorbing some of the kinetic energy.

In addition to the fenderwork fixed to the structure, loose fenders of brushwood, rope-coils or the like are generally used to break the impact, and by their deformation a certain but uncalculable amount of energy is spent in addition to their merely protective function. The energy absorbed by loose fenders is quite considerable and when it is ignored in the following a factor of safety—although unknown—is introduced.

Impact Stresses in Jetties, Wharves and Similar Structures—continued

The fenderwork is practically always of timber, sometimes with steel rubbing strips. It should be so designed that a vessel under normal conditions will be prevented from coming into contact with the structure proper.

The fenderwork is principally of three types :—

(*a*) horizontal or vertical timbers, or a combination of both, fixed directly to the structure proper and in direct contact with this over their entire length ;

(*b*) vertical timbers fixed directly to the structure in two or three points but free to bend between these. ;

(*c*) fender piles entirely free from the structure or fixed to this in one or two points.

The first type is mainly protective and absorbs little energy and only by their elastic compression. The two other types absorb a considerable amount of energy by their spring effect. This may be increased by inserting actual steel springs between the fenders and the structure proper.

The first type of fenders practically never find their application in connection with open reinforced concrete structures, with which this analysis is mainly concerned, and thus need no further mention.

Apart from the two other types directly absorbing energy, they may be considered to have the effect, that the impact-force as far as the structure proper is concerned increases gradually from nil to its full value instead of attaining this immediately, which again means that the stresses in the structure proper may be considered as static.

The vertical fenders or fender piles should be so arranged that they will not be stressed to breaking by bending before the shipside comes into direct contact with the points of support and thereby relieve the stress in the piles between these. In the case of fender piles fixed to the structure proper at the top, this means that they should not be driven with too great a rake.

The function and design of the fenders will be further illustrated by an example at the end of this analysis.

(*To be continued*)

Record Revenue Dundee Harbour Trust.

Mr. Alexander Smith, Finance Committee Convenor, of the Dundee Harbour Trust, reporting on the financial position for the first time since the beginning of the war, indicated that they had been able, this year, to make decreases in the rates which had risen to 100 per cent. above pre-war rates. The two reductions so made had brought their figures back to 25 per cent. above schedule.

Capital expenditure had been practically cut during the war and revenue had reached record proportions. For the past year, they had an income of £162,097 giving a balance after clearance of all commitments of £22,069. This had been placed to suspense account to meet deferred expenditure.

The Tay Ferries showed a surplus on the year's working of £9 and, with the resumption of motoring, there was a prospect of increased revenue.

If trade were sustained on last year's basis, the harbour would show a profit in the incoming year for which expenditure was estimated at £139,698.

The Port of Southampton and the Western Offensive.

The part played in the liberation of Europe by the Port of Southampton, where the docks are owned by the Southern Railway, is revealed in the figures now disclosed of military traffic handled between " D " Day and " VE " Day at the port. Well before the end of 1944, the millionth soldier of the U.S. Army had sailed from Southampton, and in all a total of 2,840,346 British and American personnel, together with civilian refugees and prisoners-of-war, were either embarked or disembarked between " D " Day and " VE " Day. During this period, the shipment of stores to the Allied Forces amounted to 1,412,205 tons, whilst the equipment despatched from the port included 257,680 vehicles, tanks, etc. In addition, rail stock and locomotives were continually shipped, including 20,516 wagons, 770 locomotives, 39 ambulance trains, 22 breakdown trains, and 16 mobile workshops.

The Cape Town Graving Dock.

The large new graving Dock at Cape Town is now practically completed and the official opening by His Excellency the Officer Administering the Government, the Right Hon. N. J. de Wet, will take place on September 18th. The Government has decided on the recommendation of the Table Bay Harbour Advisory Board to name the dock after the Minister of Transport, Mr. F. C. Sturrock, " whose initiative and personal interest were largely responsible for giving practical effect to the plan for equipping Cape Town Harbour with a modern graving dock capable of serving every size and type of ship."

Belfast Harbour Board.

The Belfast Harbour Commissioners have appointed Mr. James Alexander, M.Inst.T., general manager and secretary, in succession to the late Mr. W. J. Watkins, whose death is recorded in this issue. Mr. Alexander has been acting for some time as deputy to Mr. Watkins. He entered the service of the Board as an apprentice clerk in 1908. He has been deputy chief executive of the Port of Emergency Committee during the war.

Sir Ernest Herdman, the chairman for many years of the Commission has intimated his intention of retiring at an early date from the chairmanship and also of resigning his membership of the Board as he is returning to his home in England.

Floating Wharves at San Francisco.

Two large self-propelled " car floats " or floating wharves have beeen installed in San Francisco Bay. With a tapered bow, the car float is able to fit into the car ferry berth at Triburon, where freight cars of the North Western Pacific Railroad are run on to tracks along the centre line of the deck of the float. Eight large freight cars can be taken on board. Propelled by six sea mules, which are essentially outboard motors on a large scale, the carfloat brings its cargo out to the anchorage where the cargo ship is waiting. Loading platforms on each side extend almost the length of the vessel. Each float is about 300-ft. long by 65-ft. wide and is manned by a crew of 23 men. The floats are used to serve cargo ships with loads ranging from 100 to 1,000 tons, principally explosives or ammunition, though they also bring food and other supplies for Navy use.

Effect of London Dock Troubles.

In the House of Commons on August 24th, Sir Waldron Smithers asked the Minister of Labour if he could give figures to show the number of man-hours lost at the docks owing to strikes and go-slow methods; and what was the loss expressed in terms of money.

Mr. George Isaacs, in a written reply, stated: On the basis of such information as is available in my Department the aggregate number of man-days lost from the beginning of this year up to the end of July in stoppages of work arising from industrial disputes at docks in Great Britain is estimated to be about 170,000. This total relates only to stoppages of work and takes no account of the time lost in " go slow " working, as to which statistics are not collected. Information is not available on which any estimate can be made of the loss resulting either from stoppages of work or " go slow " working expressed in terms of money.

" Secret Pier " at Jersey City, U.S.A.

It has just been disclosed in a statement issued by the New York Port of Embarkation Authority that a " secret pier " at Jersey City, New Jersey, U.S.A., was " the major shipping point of World War II."

This pier, " the largest installation of its kind in the world," was the loading site for 2,696,811 tons of bombs and ammunition. The pier, is 1,800-ft. long and stretches into the harbour from a 2,200-ft. causeway. The installation lies half-a-mile south of the Statue of Liberty.

" The operation was one of America's best kept war secrets and was carried out with such devotion to safety precautions that there was only one serious fire," the statement added. This fire occurred aboard the steamer *El Estro* on May 24th, 1943, with 1,400 tons of explosives aboard. The ship was towed from her berth and sunk in deep water before any damage could be done except to the vessel itself.

Dredging Machinery

*Discussion at the Institution of Civil Engineers on Dr. Herbert Chatley's Paper**

The President observed that many members had expressed the wish that a hydraulic experimental station should be established in Great Britain on the lines of that in Pittsburg, Pennsylvania, and had advanced many good reasons for the establishment of such a station. The Author had added a further reason for it, and they would be very grateful to him for having done so.

Mr. J. A. Seath observed that the Author had referred to the large demands which would probably arise for dredging craft after the war, owing to the suspension of dredging and the deterioration of craft due to the lack of repair facilities. Practically no dredging vessels had been built, so far as Mr. Seath knew, during the past six years, and, speaking as a member of the Civil Engineer-in-Chief's Department, Admiralty, which had been responsible for carrying out the numerous dredgings required for the Navy during the war, and as a member of the Dredging Co-ordinating Committee, he could say that it had been a matter of great surprise to him to find how old most of the dredging vessels in Great Britain were.

In spite of the enormous outputs that could be obtained from suction dredgers, of the drag and other types in the right material, he thought that the bucket dredger was still the mainstay of British dredging practice.

The Author had suggested that British practice favoured heavy design and the geared drive. Mr. Seath's own experience had led him to the opinion that the belt drive was the better all round, and for dealing with all classes except very heavy material, he thought the lighter Dutch dredger could more than hold its own.

Successful dredging was really a matter of maintaining the vessels in repair and keeping them working. The bucket string took most of the wear and tear, and that was where he would like to see improvements made. The usual bucket in a British dredger consisted of a cast-steel base with a mild steel body and a reinforcement of manganese steel or mild steel, all riveted on. He suggested that, in view of the enormous development which had taken place in welding technique during the war, a better, more serviceable, and lighter bucket could be built by welding instead of riveting; for reinforcement it was possible to obtain hard alloys for coating mild steel which would give quite as good an effect as manganese.

The next major items of repairs in bucket dredgers were the bucket lips and bushes and the bucket pins. His own experience had been confined to manganese steel, a material which he thought was inclined to be very variable. The properties which manganese steel supplied were toughness and resistance to abrasion, but unfortunately it lacked hardness and was inclined to squeeze out. He would like to hear whether any material was known which combined the properties of manganese steel with hardness. The links in the bucket string continually required to be replaced. They cut into the tumbler faces, and he wondered whether they could not with advantage be replaced by cast-steel trays, possibly similar to a bucket base. Such trays would carry a considerable quantity of material in suitable dredging. The weight on the string would have to be taken into consideration, and that raised again the old question of whether close-connected buckets should not be adopted, as in tin mining dredging. The problem of repairs to tumblers had been fairly well solved by the big advances that had been made in welding technique. The principal improvement, however, required in the bucket string was lubrication. He had never seen a lubricated string, but he did not see why one could not be devised.

Would it not be possible to standardize the parts of a string for different capacities of buckets, that was to say, to standardise them for a 20-cubic-foot bucket, and so on? The experience of the Admiralty during the war in supplying spares for the diversity of plant that had been under its care had indicated that that would be an enormous advantage.

The Author had referred to the American preference for dipper dredgers as possibly being a matter of fashion and custom. In Mr. Brown's Paper* particulars were given of outputs of dipper dredgers, with 10 or 15-cubic-foot bucket capacities, in hard material, which compared more than favourably with anything that could be done in the same class of material by bucket dredgers of equal capacity. Mr. Seath could not think that that difference in practice was due solely to the fact that the conditions in America were different from those in Great Britain. He felt certain that for hard dredging the dipper dredger was a better tool than the bucket dredger.

The Author had enumerated the increases in the size of suction dredgers, but so far as Mr. Seath was aware there had been no corresponding development in bucket dredgers. In fact, he believed that the 27-cubic-foot bucket dredger was the largest that was now ever built, and he wondered what was the reason for that limitation, because dredgers such as the *Lord Joicey* had buckets of 54 cubic feet capacity.

During the war the Admiralty had had to dredge many anchorages for a large number of shallow craft required for war purposes, and in same cases it had been found extremely difficult to carry out that dredging. The number of small bucket dredgers in Great Britain was very small, and in dealing with hard material it had been essential to employ a large and heavy dredger, with uneconomical working, heavy overdredging, and generally great difficulty. He thought that the proper solution of the problem would have been to use a small dipper dredger, but, so far as he was aware, such dredgers were almost non-existent in Great Britain.

Except where space was an essential feature, as in the case of hopper dredgers, or in very small dredgers, where power was not of paramount importance, he did not think that Diesel power would supplant steam, because of the direct pull given by steam in comparion with the power derived from the revolutions of a flywheel. In a country where oil was cheap, however, the position might be different.

Brigadier J. A. S. Rolfe agreed that it was time something was done to improve dredgers in Great Britain, but he was not sure that the study of soil mechanics would help very much. It might help the special dredger which was working in one class of material all its life, but he did not think it would help the general purpose dredger. Improvements in the case of the latter would probably lie more in operation, which was a subject that very few engineers troubled to study. He had been surprised at the economies which could be effected by really studying the operation in collaboration with the dredging masters.

He could not agree that a gear-driven dredger was better on soft materials and a belt-driven dredger on hard materials. He had had a good deal to do with gear-driven bucket dredgers working on broken rock, and he was sure that no belt-driven dredger would have stood up to the work.

Whether a dredger should be self-propelled or dumb depended almost entirely on the work for which the dredger was engaged, but he was not sure that anyone would agree that the self-contained hopper was desirable; he did not think, except in special cases, that it was ever justified. The dropping and picking up of moorings was a very long and tedious job, and nobody who had worked a bucket hopper would be in favour of the self-contained hopper.

The deposition of the spoil was probably one of the most expensive items in dredging and large sums of money were spent every year in carrying water about in a hopper barge. He had overcome the difficulty by making a very good seal to the hopper doors, installing a small pump, and pumping out the hoppers on the return trip. He had found that an ordinary 800-ton hopper, instead of arriving at the dredger with about 400 tons of water, then carried only about 50-60 tons, and the ordinary filling time of 24 minutes was increased to about 50 minutes. If he had been able to convert all his barges in that way, it would have meant the use of two barges instead of three, which would have effected considerable economy.

There could be no doubt about the immense power of a dipper dredger. He had read that the Americans preferred the dipper

* The Paper was reproduced in the issues of July and August, 1945.

* Min.Proc.Inst.C.E. Vol. cciii p. 212.

Dredging Machinery—continued

dredger on account of the ground formation in their country. They were liable to strike many boulders, and it was understandable that the dipper dredger should be found to be so much more useful. He would be glad to have that confirmed, because he had never been able to find the authority for it again.

He agreed with the Author that a single grab mounted on a pontoon was probably the most economical unit, working into hopper barges. Multiple-grab drdegers, with their own hoppers, were difficult to operate, and if anyone wanted to spend a very interesting week he would advise him to take any existing grab dredger and see how it could be operated without wasting an immense amount of dredging capacity. He himself had had to handle the largest dredger in the world, with four grabs, and he had never solved the problem of the orderly progression of that dredger over the ground.

With drag suction dredgers he was in favour of keeping the suction head floating. If it were kept floating up and down with the material, and the vacuum on the pump were kept steady, very much better results were obtained than by allowing the vacuum to fluctuate and filling the hopper with much unnecessary water and practically no material.

He had carried out a number of experiments upon drag suction heads, dealing almost entirely with mud. He had made heads of very shape, and had finally found that for ordinary drag suction dredging in mud a plain bell-mouth with a little hood over it gave better results than a Frühling and Allen scraper or any other form of head. It was very elementary and very simple but it produced the mud.

The procedure he had described with regard to water in the hopper applied equally well to the suction dredger. He had installed a suction pipe leading out of the hopper to the main pumps and had pumped the water out on the return trip, so that only about 50 or 60 tons remained in the hopper on its arrival at the dredger. That had enabled him to get a really reasonable load, about two-thirds the consistency of the mud as it stood on the bottom of the sea.

In suction dredgers the tendency was to put the dredging bridge forward of the hopper. He had tried putting it both forward and aft and he considered that, if the dredging master were aft of his hopper and could see both it and the discharges, even though he had his pump vacuums to guide him, he would obtain much better results than if he were forward of the hopper and could not see the hopper and the work he was doing. A bridge at the aft end, giving a clear view of the hopper and its discharges, certainly paid.

Brigadier Rolfe considered that the operation of dredgers was much more important than any improvements that could be made by a knowledge of the materials. Young dredging engineers should collaborate with the dredging masters, sympathise with them, and try to understand their problems. They should not expect their dredging returns to be put in on the rated output of the dredger, but should try to understand why that could not be done and why the dredging masters could rarely work to more than 30 per cent. of the rated output. Then they would find that they had a very interesting job and one which was well worth while.

Mr. C. C. Gover observed that, as a dredging contractor, he viewed the subject of dredging in a rather different light from that of consulting engineers and harbour authorities.

The ordinary, plain type of pontoon dredger—in Great Britain at all events—was the mainstay of all dredging operations, particularly for dredging contractors. A contractor very rarely had the opportunity of having anything to do with the designing of a dredger which was intended for one long constant operation, though very often harbour authorities had that opportunity.

A bucket dredger was planned, designed, and built into a pontoon to work afloat, and, as the Author had remarked and Mr. Seath had emphasised, it had a very long life, during which it had to do very many different jobs, with different materials, various types of wear, and wide variations in tide, so that it had to be able to dredge fairly efficiently under all sorts of different conditions. Therefore, whenever, a dredging contractor had a dredger built he always had to bear in mind, first and foremost, general utility. Possibly for five out of every six jobs that a bucket dredger was called upon to do for a contractor a more suitable dredger could be found if it were required to do only the particular job in question. He agreed that in some cases it was better to have a geared drive and in others a belt drive, but, from the point of view of general utility, he considered that nobody who had any considerable experience of dredging would have the slightest hesitation, if he had to choose between the two, in selecting the belt drive, for the reason mentioned by the Author, namely, its elasticity.

Another very important question to the dredging contractor was the difference in design between the British practice of a very heavy hull and heavy design throughout, and the Dutch practice of a very much lighter design. From the point of view of working operation only, upon which depended output, upon which in turn depended cost, there could be no doubt that an unduly heavy hull was in every respect a drawback. The part that did the work was the bucket chain. A great deal of money was put into a dredger, and, from the contractor's point of view, the hull was dead money, as its sole purpose was to enable the machinery to float. The heavier the hull the more difficult it was to handle, the more numerous was the crew, and the more expensive the whole operation, because everyone who had anything to do with bucket dredging knew that, apart from any serious breakdown, the main delay to output was the shifting of the moorings. Normally there were six moorings ; all had heavy chains or heavy wires and heavy anchors, and the faster the dredger worked the more often it was necessary to stop work to shift the moorings. The heavier the hull the heavier the moorings, and, if output decreased for no other reason, the dredging master would have a wonderful story to tell about the appalling difficulty he had had in shifting his moorings.

Mr. Gover considered that, as the dredging industry in Great Britain was very small, it had not been considered much by British builders in the past. They were in the position of having a more or less closed market so far as harbour authorities' plant was concerned. Authorities such as the Crown Agents, who always bought British plant, had, he thought, regarded dredgers rather too much as ships, so far as the hull was concerned, and the builders had not been very willing to fall in with the views of contractors, who, in the nature of things, were only able to place an order with one dredger builder or another fairly infrequently. The result was that, as the dredging industry was much bigger in Holland, where considerably more attention had been paid to the requirements of the contractors, an undue quantity of Dutch-built plant existed in Great Britain, especially among the plant owned by contractors. A contractor had to keep his head above water if he was to continue in business. He might have a bucket dredger into which he had put a large amount of capital, and experience showed that, in the case of an contractor, any individual dredger spent a good deal of its life idle. A dredger of the type in question involved hopper plant also, and when the dredger was idle the hopper plant was idle.

Mr. Gover emphasised the above points because the Author had stated—and Mr. Seath had commented on the fact—that most of the dredgers with which he had to make do during the war were on their last legs. That was true of most of the dredgers in Great Britain to-day, and it was certain that even the dredging contractors would have to build general utility dredging plant after the war. All of them wished to build in Great Britain, and they felt that the British dredger builders ought to take thought and consider more the type of plant which had been built in Holland and had given very good service as general utility plant. If that were done and if the questions of actual maintenance and running costs were considered, especially on the Clyde, it would be of great advantage to the dredging industry in general, and dredging plant which embodied some of the better features of the Dutch-built plant would be built in Great Britain after the war.

Mr. H. B. Hurst observed that a dredging unit of any kind was probably the most expensive machine tool there was for an apparently simple operation and it was not possible to decide on the best type of vessel, or whether self-propelled with in-built hopper, without regard to the purpose and place for which the

Dredging Machinery—continued

dredger was required. Contractors with a world-wide practice wanted general purpose machines and usually could not have dredgers built for particular kinds of material or local conditions. A small authoity had to compromise on the type best suited to the bulk of its work, whilst a large authority could afford to have a multiple fleet of several types.

Some opinions favoured that all bucket dredgers should be dumb, but in many cases it was profitable to have a bucket dredger self-propelled, with its own in-built hopper. The most obvious case was where loading time was long in relation to depositing time, which might be short. In such cases it would be uneconomical to keep capital in hopper barges lying idle because material was slow to get.

He was entirely in favour of the light Dutch type of dredger, except where abnormally hard material had to be cut. The Dutch type could deal with much heavy ground, and in his opinion, British builders erred on the side of too much weight for general purposes.

He was also in favour of the belt drive for its elasticity. The friction gear formerly embodied in the British type of dredger, which consisted of a number of elm blocks in the top transmission wheels, could not be accurately adjusted in varying weather conditions. As a consequence, dredging masters had been impelled sometimes to lash up the friction gear so that it could not slip under any conditions, occasionally resulting in a broken bucket chain with serious results.

He thought that the bucket dredger was the best general purpose machine. There were a few things which a dipper dredger could do and a bucket dredger could not, such as lifting very heavy boulders or large pieces of broken rock, but the heavy bucket dredger was no mean servant in dealing with boulders or rock up to the limiting width of the ship's well. He considered that a heavy bucket dredger would pull virgin rock better than a dipper dredger, because it concentrated its whole force on a much smaller area of rock when it could get a grip.

Standardisation of components was a very desirable ideal, but many standards would be necessary of buckets, lips, links, pins, bushes, rollers and tumblers, for large, medium, and small dredgers, and each for rock or free-getting material. Moreover specifications would need to be standardised where that had not already been done, to include the various materials which different authorities preferred for the same purpose.

With regard to abrasion, the Author's reference to rubber was interesting. Some years ago, Mr. Hurst had used some small proprietary pumps, up to only 6-inch suction, in which the impeller blades were entirely of rubber vulcanised on to the moving impeller disk. He had used them for drainage work from chalk tunnelling, containing a mixture of chalk particles, with a certain amount of fine grit and flint chippings. The efficiency of those pumps was very high and the rubber stood up well to the abrasion. Perhaps the application of rubber in some form might improve the efficiency of dredging pumps, and investigation might produce interesting results.

With regard to shallow dredging, an unorthodox method which had been adopted with great success, in some cases, was the use of gravel pumps with dilution jets, mounted on pontoons, discharging by pipe-line into hopper barges or other near deposit. That method had been used successfully for very considerable quantities of suitable material.

Mr. John Palmer stated in writing that he felt diffidence in expressing his views on a Paper dealing with dredging quantities of the order of 8,000,000 cubic yards per annum, as his own dredging experiences on the East and South Coasts of England during the past four years totalled only about one-tenth of that quantity. He was very interested in the output figures given in the Table; he himself usually tried to quote outputs for dredgers in hopper yards per week, as the most useful figure ; taking for convenience a round figure of 50 working weeks in the year, the Author had given the output for a 23-cubic foot bucket dredger as 25,000 hopper yards per week, and for a 1½-cubic yard grab dredger 6,000 hopper yards per week ; in both cases, Mr. Palmer's experience was that something about half of those outputs was all that could safely be relied upon.

The question self-propelled versus stationary dredgers had also been dealt with in the Paper, and Mr. Hurst had indicated in the discussion under what circumstances a self-propelled bucket dredger was economical. So far as the grab dredger was concerned, however, Mr. Palmer could not agree with the Author that the pontoon dumb type was the most generally useful ; one of the most useful all-round dredgers he had employed during the war had been a self-propelled grab type with two cranes for either 2-yard or 1½-yard grabs ; that vessel was about 185 feet in overall length, with 32 feet beam and 600 tons hopper capacity ; a particular feature of the cranes was the high hoisting-speed of 200 feet per minute; the forward crane could plumb all around the bow end and consequently that dredger was most useful when working along the coast, as she could dig her own flotation where necessary ; both cranes were able to swing in and discharge over the hopper without fouling one another.

The Author had made the definite statement that "For wholly loose coarse granular materials suction dredging is the most economical method of excavation." Therefore it would be very helpful to all engineers if he would add one more column to the very fine list of Whangpoo Conservancy Board plant in Appendix II to give the approximate total annual cost of operating each item of plant ; and would state the normal sterling value of a Shanghai dollar.

Would the working man on the job, the Dredging Master and the Ship's Engineer, be more easily trained to operate successfully the bucket type of dredger than the drag suction dredgers mentioned in the Paper? Mr. Palmer was a little frightened by the Author's warnings of the difficulty of working the suction dredger in bed material of varying resistances ; and he wondered whether in fact the ordinary Dredging Master, particularly in the Far East, could acquire the necessary skill to utilize fully the expensive tool he was handling.

The Author, in reply, observed that Brigadier Rolfe had been rather critical of his suggestions about the use of science and thought that the study of the operation was of much greater importance. Motion study, which could almost become a scientific operation, was of tremendous importance, and he would not wish to exclude it. He thought that every avenue should be explored.

Mr. Gover had been unduly modest in his picture of the role of the contractor. The vast majority of dredging jobs in Great Britain were done by contractors, and they generally knew much more about the subject than did the harbour engineers, who had a great deal to learn from them, particularly in the matter of operation. As Mr. Gover had said, the contractor was concerned with doing the work cheaply, and he achieved that by studying the motion of the various parts and so getting the highest output in the end.

The only sense, however, in which operation bore on the Paper was where the design of dredging plant needed to be modified to suit operation, for example, in the provision of pumps for removing surplus water from hoppers.

Mr. Seath's reference to the use of close connected buckets was valuable. For equal capacity it implied smaller buckets which might not empty so freely as large ones.

Brigadier Rolfe's plain bell-mouth for drag suction of mud was undoubtedly good for soft mud, but if appreciable cutting effect was required that shape might not be the last word.

In relation to operation and design, two matters were of great importance :—

(*a*) the necessity or otherwise of stripping the top tumbler and reduction gear for sea voyages. If that mechanism could be constructed so that either it did not have to be stripped or could be rapidly and easily taken down and reassembled much serious delay could be avoided.

(*b*) the picking up of moorings and recovering position after a hopper dredger had returned from a trip to the dump. The validity of Mr. Hurst's arguments for the hopper bucket dredger was largely dependent on the facility for recommencing work after dumping.

Dredging Machinery—*continued*

Mr. Hurst's suggestion as to the use of small suction dredgers for dealing with shallow cuts was quite good, provided the jetting was adequate to stir up the material when it was cohesive and that the spoil could be transported without excessive quantities of water.

In reply to Mr. Palmer, the value of the Shanghai dollar during much of the period referred to was about two shillings. The bucket dredging cost about $0.20 per cubic yard barge measure, the transport about $0.20, the pumping ashore about $0.10, and the dike-work about $0.20. Those figures were indicative only. The suction dredging in the Yangtze estuary cost about $0.20 per cubic yard situ, including dumping.

In the technique of suction dredging, the skill of the master was undoubtedly a big factor, but at one site an intelligent man should not take very long to acquire it if he was properly instructed in the first instance. The moored suction dredger working in, say, gravel was, however, a much simpler tool to use.

The Author was much indebted to the various speakers for their sympathetic reception of the Paper and for the very useful comments they had made.

Obituary

Mr. M. J. Watkins, C.B.E.

The death of Mr. Michael J. Watkins, C.B.E., General Manager and Secretary, Belfast Harbour Commissioners, took place at his residence, 12, Deramore Park South, Belfast, on the 15th August, after an illness lasting several months.

Mr. Watkins had been General Manager and Secretary to the Belfast Harbour Commissioners since March, 1922, when he succeeded the late Sir David Owen, and during his period of service he played a prominent part in the development of Belfast Harbour, which now ranks as one of the leading Ports in the United Kingdom.

During the war Belfast Harbour rendered a valuable contribution to the war effort and, in recognition of outstanding service, Mr. Watkins received the honour of Commander of the Order of the British Empire.

Mr. Watkins was a native of Merseyside. Son of the late Captain John Watkins, a master mariner of Liverpool and Old Colwyn, he was educated at Liverpool Institute and Liverpool University and in 1892 entered the service of the Mersey Docks and Harbour Board, eventually becoming an assistant to the General Manager and Secretary.

After 20 years' experience at Liverpool he was appointed Assistant Secretary to the Humber Conservancy Board and 10 years later received his appointment as General Manager and Secretary at Belfast.

He is survived by his wife, a son (Major John Watkins, R.A.O.C.) and two daughters.

The Port of Portland, Victoria

Contemplated Developments

It is announced in the *Melbourne Herald* that a scheme of important developments is recommended by the Victorian State Parliamentary Public Works Committee for execution at the Port of Portland. The works, which include a breakwater and a deep water wet dock are estimated to cost £2,300,000.

The committee express the opinion that a further port with adequate shipping facilities and still water on the Victorian coast, between Melbourne and Adelaide, is desirable for the following reasons:—

To promote development of Western Victoria, and to assist decentralisation of population and industries.

To provide an outer Victorian port well equipped for defence purposes.

To reduce the costs of transportation of Australian exports from and imports to, Western Victoria; and

Portland is the most satisfactory site for such port.

The report says that the evidence on costs and details of improvements to provide adequate harbour accommodation in still water at Portland was such that the committee was unable to make a definite recommendation of works to be done. It is of opinion, however, that construction of a breakwater and an inland dock at a cost of £2,300,000 would be preferable to the construction of a breakwater and new pier at Otway Street to cost £1,860,000, or to a breakwater and pier as set out in any of the proposals submitted to the committee by the chief engineer of the Public Works Department.

Previous reports strongly emphasise the necessity for a breakwater, and the detailed scheme of works suggested includes such breakwater, which would be necessary whether Portland is to be served by an inland dock or by a pier or piers.

The committee considers that when engineers have decided the alignment and method of construction of the breakwater work should begin at once, as it would provide shelter for shipping while other works were being decided and proceeded with. It is pointed out that with the divided control of ports and harbours in Victoria, there is danger, even if all the advantages of a first-class port are provided for Portland, of competition by established ports being detrimental to the progress of the outer port, and it is urged that there should be the closest collaboration between Victorian harbour authorities to secure a balanced development of ports and economic use of plant and equipment.

It would be useless, the committee says, to spend lavishly to establish port facilities if freights are not such as to induce the export and imports of goods from and to those districts nearer to Portland than to Melbourne or Geelong. A network of railways servicing a port are essential, but the committee believes that the minimum railway requirements would be dependent to a large extent on what harbour works further investigation would show to be practicable. The committee, therefore, recommends that an engineer or engineers with specialised knowledge be appointed to make surveys and draw up plans and specifications (including estimates of costs) of all works necessary to make Portland a first-class port providing still water in all weathers and that the surveys be started as soon as practicable, so that a feasible scheme may be implemented in the early post-war period.

Greymouth Harbour Entrance.

In connection with the silting up of the harbour entrance at Greymouth, South Island, New Zealand, which was the subject of a Report published in the July issue, we are informed by the Harbour Engineer (Mr. D. S. Kennedy) that he has under construction a Scale Model for the purpose of studying the effect of the proposals. The model scales are one chain to 1-in. horizontal, and ¼-in. to the foot vertical. All the variables of river flow, tides and littoral drift are allowed for in the model tank, which is 35-ft. by 25-ft., covering the tidal compartments and extending up-river to the end of tidal influence, and seaward about 2 miles an on each side of the breakwater entrance.